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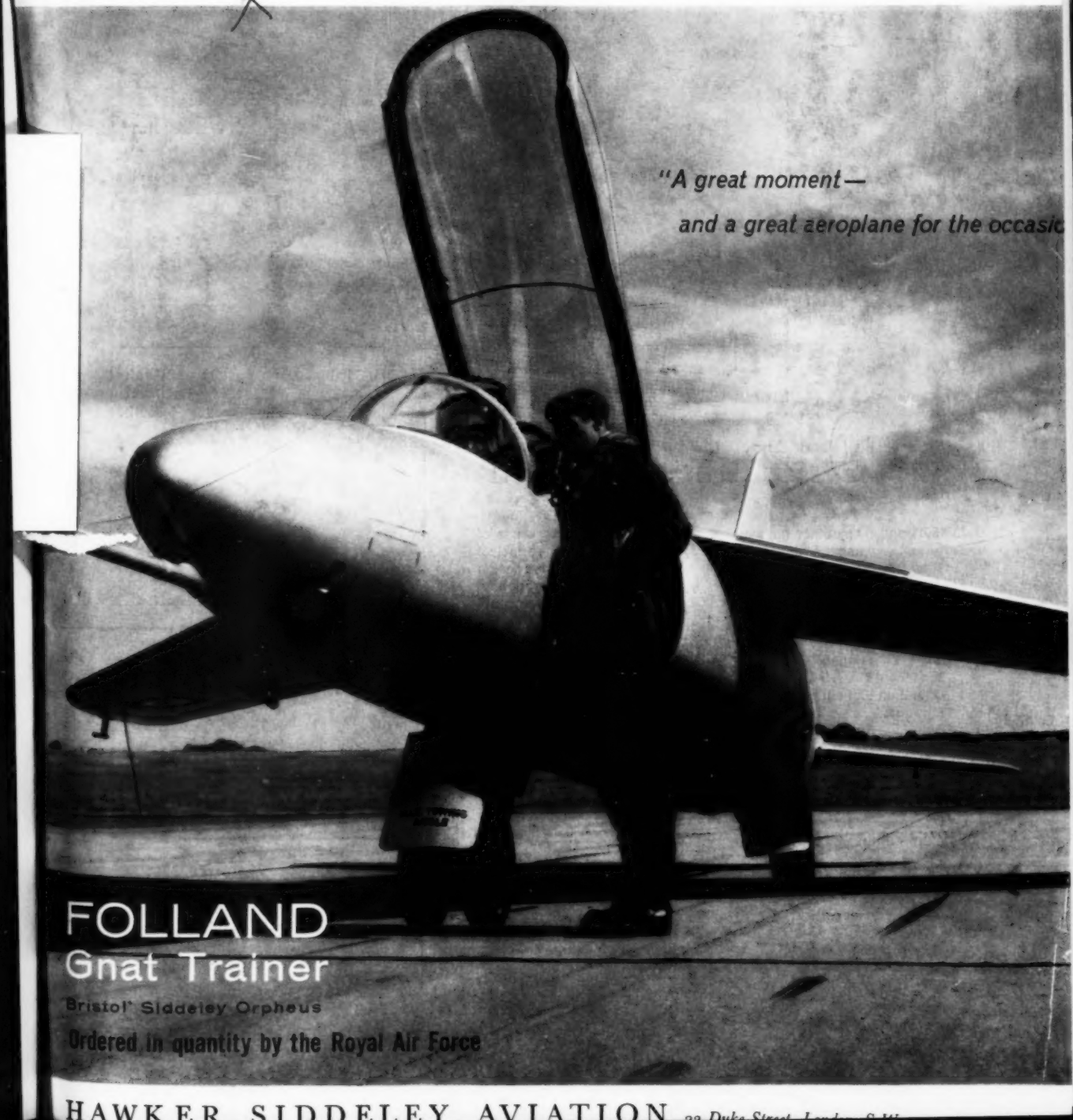

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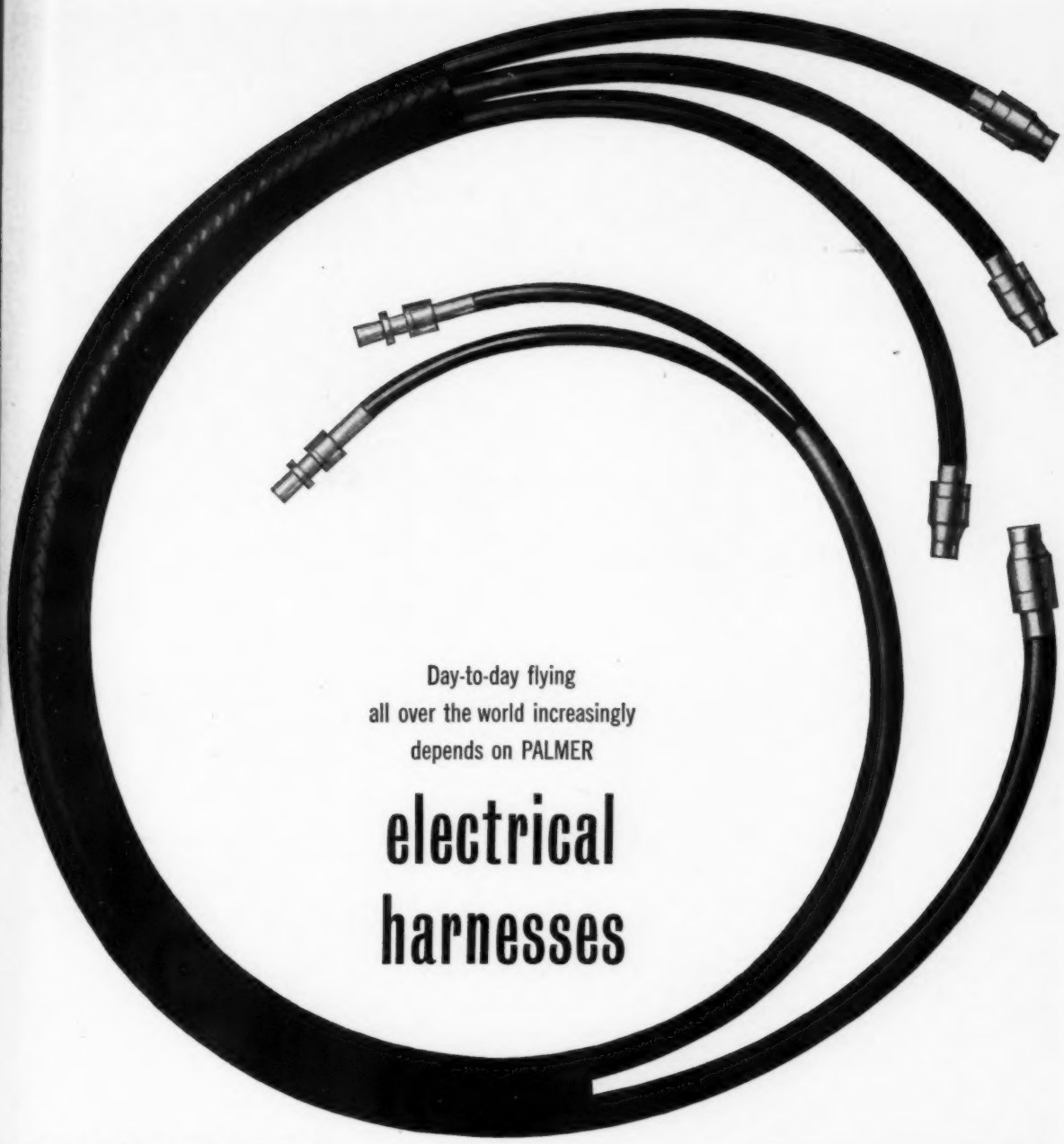

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No 2717 VOLUME 79 THURSDAY 6 APRIL 1961

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Studies in Supersonics

COINCIDENT with a report that proposals for an intensified study programme for a supersonic airliner have been approved by America's Budget Bureau, and will shortly be sent to President Kennedy, comes the notable paper abstracted in this issue. Its significance is that the author, Dr A. E. Russell, is head of the design team which is studying Britain's own "SST"; and we firmly believe that President Kennedy's advisers will be wise to defer their submissions until they have studied Dr Russell's prognosis.

It is now widely accepted that, come hell or high water (and some such cataclysm might indeed follow) the Americans are determined to go for a Mach 3 cruising speed. The technical problems involved are as manifold as they are obvious, though, as Dr Russell remarks, they need not be regarded as uncrossable barriers. What he himself is asking is whether the effort demanded is worth undertaking when a less ambitious speed seems to offer a considerably better chance of approaching typical subsonic operating costs.

In terms of speed the Mach 3 aircraft offers a dubious advantage. On a sector of 3,000 nautical miles its block time would be 30 minutes less than that of a machine cruising at Mach 2.2; or on a 2,000 n.m. sector the time would be 20 minutes less. In terms of safety the "M3" appears a fearsome monster. Because the fuel must be properly insulated it is necessary to house much of the tankage in the fuselage, and Dr Russell finds it "interesting to speculate" on the hazards associated with possible fuel or vapour leaks when the temperature of most parts of the skin of the main structure is higher than the spontaneous ignition temperature (about 250°C) of conventional hydrocarbon fuels. Such reflections are no more comforting when it is remembered that hitherto most features adopted for successful airliners, including their operating speeds, have lagged seven to eight years behind military experience. As for finance, Dr Russell believes that if the Mach 2.2 airliner (which is the British idea) is to be economic for both operator and constructor, then about 50 must be sold. To achieve the same economic balance for a Mach 3 aircraft at least 200 would have to be disposed of.

Self-imposed Difficulties

Truly, as Dr Russell concludes, even supposing that technical engineering difficulties can be satisfactorily overcome, the advocates of Mach 3 still seem to be confounded with a formidable array of self-imposed difficulties. Interestingly enough, one of the more reassuring of Dr Russell's pronouncements concerns engine noise. On the runway this noise will be comparable with present levels, and shortly after take-off a supersonic airliner should be quieter than present long-range subsonic aircraft.

Remembering Mr Hall Hibbard's contention in his 1959 Plesman Memorial Lecture that there would be "insignificant differences" between the gross weight of an M2 and of an M3 airliner, we were interested (to say the least) to read Dr Russell's view on the matter. In his belief the difference will be "substantial"—actually 337,000lb against 400,000lb for a payload representing 120 passengers.

Being ignorant of the recommendations to be forwarded to President Kennedy we have no basis for criticism. But, as an American correspondent recently pointed out, the proposed Mach 3 airliner may well turn out to be a "make-work" project. It is not this journal's desire to teach the Americans how to design aeroplanes or how to conduct their national affairs. But it is very much our purpose to direct their attention to Dr Russell's paper.

IN UNIFORM: The first Armstrong Whitworth Argosy C.1 for RAF Transport Command has now been issued with its uniform. The aircraft flew on March 4 and was fully described in our issue of February 10

FROM ALL QUARTERS

U.S. Defence Budget

IN his report to Congress on defence on March 28, President Kennedy seems to have struck a very fair compromise. The actual budget for Fiscal Year 1962 (beginning July 1 next) amounts to $43,794m, and although this is an increase of $2,423m over 1961 it is evident that substantial savings will be realized by ruthless pruning of outmoded weapon systems. The following are some of the President's recommendations.

Nuclear Aircraft Nearly 15 years and about $1,000m have been devoted to this field "but the possibility of achieving a militarily useful aircraft in the foreseeable future is still very remote." The January budget recommended a severe curtailment, eliminating either the indirect- or the direct-cycle powerplant (it did not say which); the President believes the time has come for "a clear-cut decision," and suggests termination of the entire programme. The Atomic Energy Commission will continue much of the work for eventual industrial applications. The decision saves $35m in 1962 and obviates the expenditure of roughly $1,000m required to reach the flight stage.

Polaris "I strongly recommend that the program be greatly expanded and accelerated." Ten more submarines are authorized (making a total of 29), and deliveries from June 1963 will be one ship per month. This will cost $1,340m over four years. Development of the 2,500 n.m. Polaris A-3 is being accelerated, and will replace the A-2 a year earlier than planned (i.e., presumably the spring of 1963).

Minuteman "Production capacity should be doubled"; and the emphasis is on the word "capacity," for actual deliveries will not be changed. R & D will be accelerated, and although the three mobile (railway) squadrons funded in the January budget should be replaced by silo-based squadrons, development of the mobile Minuteman will continue.

Skybolt "I recommend that an additional $50m . . . be added . . . to enable this program to go forward at an orderly rate."

Snark This intercontinental air-breathing missile is eliminated, and its SAC personnel will be posted to other units.

Titan The two final squadrons are eliminated, saving $270m; this cost is much greater than that of the Minuteman squadrons which will be available at the same time (1964).

Eagle "The January Budget did not include funds for the continued development of the Navy's F6D Missileer fleet defense aircraft, but funds were included for the continued development of the Eagle missile in the hope that it could be adapted for use by some other aircraft. I am now advised that no such alternative use is in prospect, and I have directed the cancellation of that project, with a saving estimated at almost $57m in 1961-2."

Boeing B-47 The phase-out of medium bomb wings will be accelerated, and the personnel thereby made available will be required for the expanded alert programme (below).

Boeing B-52 "Our existing bomber forces constitute our chief hope for deterring attack . . . prior to the completion of our missile expansion." There will be no further procurement of B-52s, but the President is asking for funds to complete the support facilities needed to maintain one-eighth of the entire force on airborne alert at any given moment. Moreover, $45m is requested to keep about half the force on a 15min basis, and to ensure that a dependable notification of any surprise attack can always be accomplished.

NAA B-70 "The B-70 would not become available in operational numbers until well beyond 1965. By that time we expect to have a large number of ICBMs . . . In view of the extremely high cost of the B-70 system, its lesser survivability as a ground-based system and its greater vulnerability in the air compared to missiles, its capabilities as a second-strike system do not appear to have sufficient advantages over a much less expensive missile, or even a B-52 or successor bomber equipped with Skybolt . . ." The President recommends that the programme be continued to produce a small number of prototypes, together with bomb/nav systems and research into manned systems operating in an ICBM environment. Even on this basis, the programme will cost $1,300m before it is completed in 1967; $800m has already been provided.

Warning and Communications "I recommend that an additional $60m . . . be added to accelerate completion of the development phase of the Midas programme. The invulnerable and continuous command posts and communications centers (requiring an additional $16m) are only the beginning of a major and absolutely vital effort to achieve a truly unified, nation-wide, indestructible system to ensure high-level command communication and control and a properly authorized response under any conditions." The President requests an additional $226m for Dyna-Soar, Advent, Defender, Discoverer and other missile defence and penetration aids.

Other Aircraft "Expected phase-out of Navy and Air Force fighters by 1965 . . . make necessary the development of an advanced tactical fighter, emphasizing non-nuclear capabilities." This will cost $45m this year, and $25m is requested to modify the Republic F-105 "to improve its capability to handle conventionally armed ordnance items and to increase its suitability for airstrips in all types of area." Until the Lockheed C-141 (see illustration) becomes available, airlift requirements will be augmented by an additional $172m to increase the number of interim aircraft (C-130E and C-135) from 50 to 129.

Good Start

EXPORT sales by the British aircraft industry have started well this year, the total for the first two months—£25.3m—being nearly £2m more than the equivalent figure for 1960 and only £280,000 less than the record January/February total for 1959. The figure for engines, £14.3m, was about £4m more than the record figure for the first two months of any year, achieved in 1960. Dollar sales accounted for more than £11m of the total, the value of engines and Vanguards exported to Canada amounting to about £5¼m. Exports to the US (mainly engines) accounted for the remaining £5¼m.

The January/February total, £25,257,138, was made up as follows: aircraft and parts, £9,737,331; engines, £14,278,127; instruments, £579,108; electrical equipment, £525,481; tyres, £137,091. Leading customers for aircraft and parts during the period were Canada (£2,993,931) and the US (£1,803,723); and for engines, the US (£3,746,953) and Canada (£2,743,590).

News from India

IT has been known for at least four years that the Indian Government has contracted with Hindustan Aircraft for the all-Indian HF-24 fighter, and a report recently placed before Parliament in Delhi stated that progress has been satisfactory, and that the prototype will shortly fly. The initial design has been handled by Dr Kurt Tank, of Fw190 fame, and the powerplants are a pair of Bristol Siddeley Orpheus turbojets, probably BOr.12SR units with reheat. Hindustan are already in production with the Folland Gnat and its Bristol Siddeley Orpheus BOr.2 engine, and are continuing to develop the HJT-16 jet trainer referred to in our December 19, 1958, issue.

The Indian Government has adopted the Antonov An-12 as a standard heavy-duty transport for the logistic support of constructional work by the Civilian Border Road Development Board. This military version of the well known An-10A is capable of operation from short and semi-prepared strips, and can carry bulky loads with unit weights exceeding 20,000lb. The initial purchase was of eight aircraft, bought for Rupees last November. The first has now arrived, and a draft of 50 IAF aircrew has

CARGO JET: Described in our March 23 issue, the Lockheed jet freighter for MATS will be designated C-141 and powered by four 21,000lb Pratt & Whitney JT3D-8A turbofans. Payload/range performance will be 60,000lb for 2,950 n.m. or 20,000lb for 5,500 n.m.

returned from a conversion course in the Soviet Union. Several Il-14s have also been bought, again for Rupees, for use as personnel transports with the IAF.

On March 15 the Defence Minister, Mr Krishna Menon, was questioned in Parliament about the production of helicopters. Notwithstanding India's purchase of two Sikorsky S-62s for use in mountainous regions, negotiations are still in progress with the Soviet Union for the purchase of helicopters in quantity. Mr Menon denied that the low capital cost of Russian helicopters was outweighed by their high maintenance cost. He reaffirmed that India still intends to manufacture her own helicopters.

McAully Trophy Contest Postponed

THE meeting at Little Snoring Aerodrome which was to have decided the holder of the Tiger Club's Elwyn McAully Trophy (for aerobatic pilots with less than 250 flying hours) was unfortunately bedevilled with high winds on Sunday March 26, when the contest was due to take place. It was therefore decided that the conditions were unsuitable for novice aerobatic pilots and the contest was cancelled. The wind, which achieved the almost impossible task of blowing at 45° to all three runways, provided some interesting examples of cross-wind circuiting among contesting and visiting pilots, and left the Chipmunks from Cranwell with very hot brake discs indeed. Among visiting aircraft were the Piper Colt, Aero 145, Air Products Aircoupe and Jodel Musketeer.

GP CAPT P. P. W. SANDS, MBE, DFC, has joined Smiths Aviation Division as personal assistant to the director and general manager, Mr L. A. Morgan. He will be based at the division's administrative headquarters, Kelvin House, Wembley Park, Middx. His last RAF appointment before retiring from the Service last February was that of station commander at RAF North Luffenham, Rutland

Lockheed's Helicopter

ACCORDING to *Western Aviation Missiles and Space*, Lockheed Aircraft Corporation are building an all-metal four-seat helicopter. It will be powered with a 305 h.p. Lycoming VO-540-B1B and have 4ft stub wings. Maximum speed should be about 175 m.p.h. Subsequent installation of a gas turbine is envisaged, but the piston-engined version is apparently intended to sell for less than $20,000.

The American magazine says that the type now under construction is the successor to a 180 h.p. Lycoming-powered two-seater which has been flying for more than a year. This is said to be gyro-stabilized on three axes and to have a top speed of about 125 m.p.h. Length is about 25ft and rotor diameter 56ft. It lacks the stub wings of the type now projected and is largely fabric-covered.

The Lockheed helicopter, in its four-seater form, is reported to have been examined by the US Navy and to be competing in an Army design competition which could result in production of 3,500 units. Initial commercial production would be about 1,500 units; so, if Lockheed win the Army design competition, production might total 5,000.

Cranwell Commandant

RETURNING to Cranwell for the third time in his RAF career, Air Cdre E. D. MacK. Nelson, CB, takes up the appointment of AOC and Commandant of the RAF College on April 16. Until recently he has been AOA at Transport Command headquarters. He first went to Cranwell as a cadet in the early thirties, then in 1952 he became Assistant Commandant.

IN BRIEF

The Ministry of Defence have announced that from October this year all movements of British Servicemen and their families from Britain to north-west Europe will be by air.

The 5th International Aeronautical Congress organized by AFITA (Association Francaise des Ingénieurs et Techniciens de l'Aéronautique) is being held during the 24th International Air Show at Le Bourget, from May 26 to June 4.

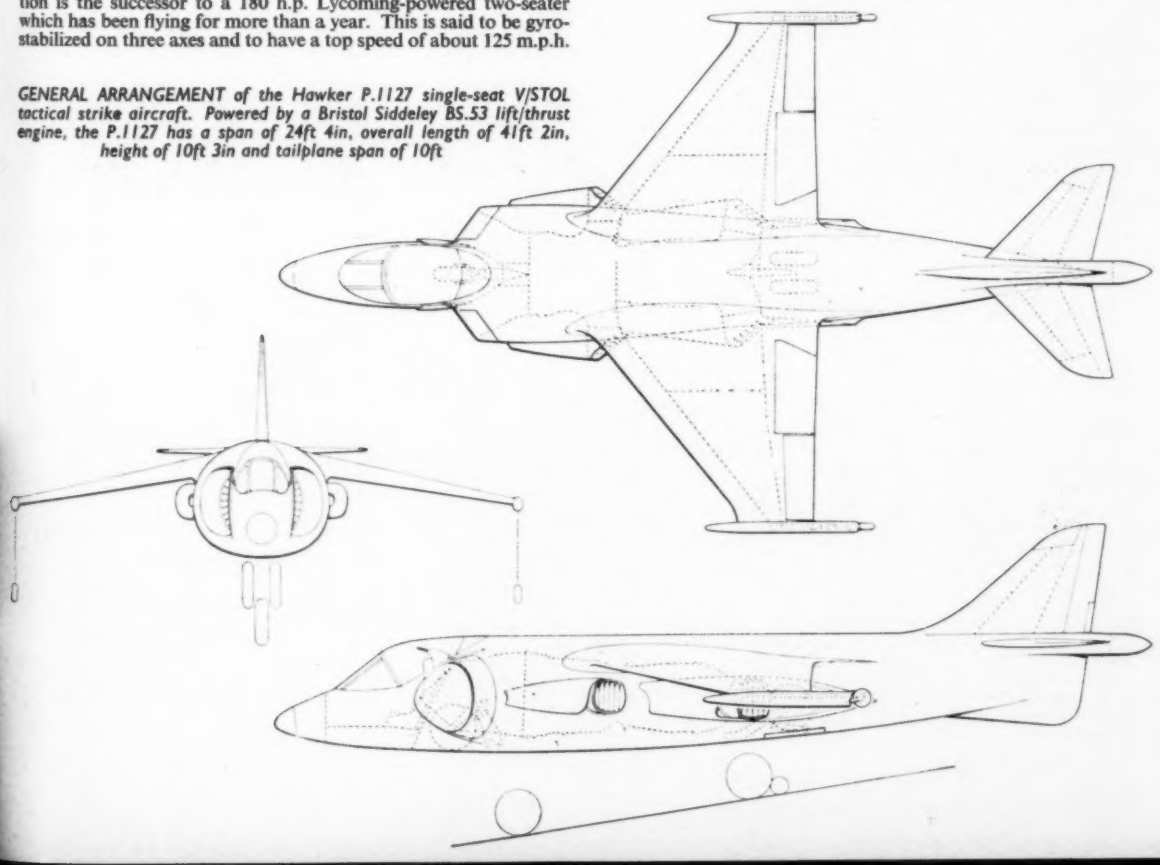
Col Joe L. Mason has been appointed Deputy Commander of the US 3rd Air Force. He has been Chief of Staff since June 1958 and will now hold both posts. During the war he commanded the 352nd Fighter Group of the 8th Air Force in England.

The USAF 10th Tactical Reconnaissance Wing, based at RAF Alconbury, will be "at home" to the public on Armed Forces Day, Saturday, June 17. RAF Alconbury is three miles north of Huntingdon on the A14.

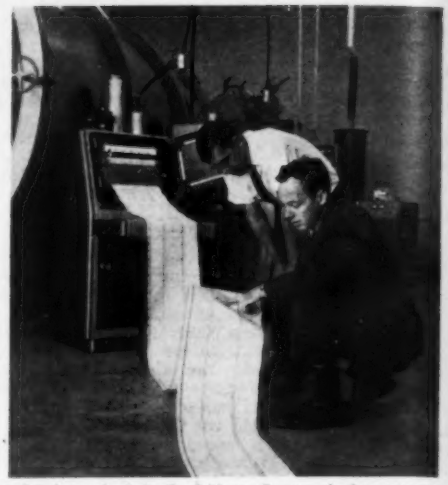
The Duchess of Kent is presenting a Standard to No XV Sqn at RAF Cottesmore, Oakham, Rutland, on the morning of Wednesday, May 3. Former members are invited to attend the ceremony and should contact the squadron adjutant as soon as possible.

The US Air Force Office of Scientific Research lecture in honour of Theodore von Kármán's 80th birthday, and the Theodore von Kármán 80th Anniversary Banquet, are being held at the Sheraton Park Hotel, Washington, DC, on May 11.

Mr S. P. Escott, managing director of Portsmouth Aviation since 1957, has become chairman of the company from April 1 in succession to Lt-Col G. B. Clarke, MBE, who has retired from the chairmanship owing to pressure of other duties but will continue to serve on the board. Mr N. H. Nash, AFRAeS, technical director, and Mr F. Wilkinson, works director, have become joint managing directors.



GENERAL ARRANGEMENT of the Hawker P.1127 single-seat V/STOL tactical strike aircraft. Powered by a Bristol Siddeley BS.53 lift/thrust engine, the P.1127 has a span of 24ft 4in, overall length of 41ft 2in, height of 10ft 3in and tailplane span of 10ft



The rough-landing capsule to be dropped on the surface of the Moon from the Ranger spacecraft is being built by Ford Motor Company's Aeronutronic Division. Left, artist's impression of spacecraft and spherical capsule; right, temperature records are checked during "lunar night" tests of the capsule in Aeronutronic's vacuum test chamber at Newport Beach, California

Missiles and Spaceflight

Exploring the Moon

THE United States programme for the initial exploration of the surface of the Moon is based on three projects—Ranger, Surveyor and Prospector—and work on the first two of these is now well advanced. These two are directed towards achieving a hard landing and a soft landing respectively, and are closely associated: they will be followed by Prospector, which will involve a mobile vehicle capable of returning samples of the lunar surface to Earth.

The objective of the National Aeronautics and Space Administration's overall lunar programme, which these spacecraft will inaugurate, is to increase understanding of the Moon and to build experience in the techniques of reaching it, operating on it and returning to Earth. The lunar missions envisaged require a number of specific techniques, many of which are to be tested in Project Ranger. These include the following, as quoted by NASA:—

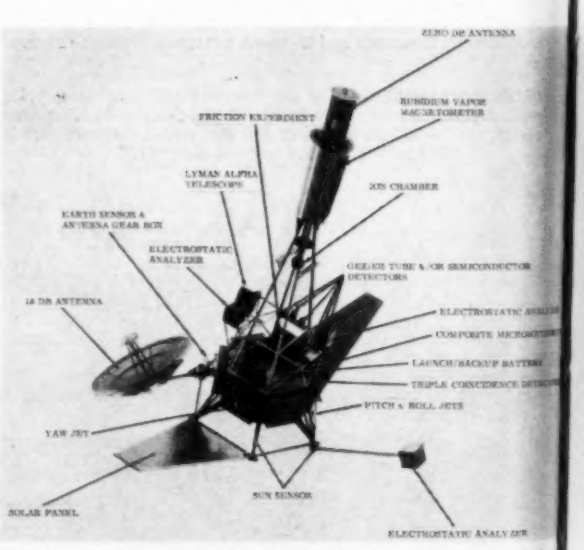
1. Time-dependent guidance parameter settings and launch of the vehicle;
2. Injection into "parking orbit," which places the vehicle at the proper location in space for departure into the desired lunar trajectory;
3. Acceleration from parking orbit to escape speed, with guidance to place the vehicle on an almost standard departure path;
4. Tracking and telemetry during the above phases, followed by orbit computation and an orbit correction manœuvre on command;
5. Data communication during transit, followed by an accurate retro-manœuvre for orbiting or landing on the Moon;
6. Automatic experimentation in orbit or after landing, with data transmission over a high-gain communication link;
7. Semi-automatic data handling after reception.

These requirements have dictated some of the basic characteristics of the spacecraft, the launch vehicle and the ground system. The most important criterion affecting the spacecraft is that its attitude in space must be stabilized and controlled to permit the pointing of a high-gain antenna towards the Earth to enable commanded rocket manœuvres to be made and to permit the use of direction-dependent instruments. The efficient use of solar power and problems of temperature control are additional consequences of using attitude control.

The Ranger project will be based on five flights of a spacecraft launched by Atlas-Agena B vehicles. The Jet Propulsion Laboratory of California Institute of Technology is responsible for the design and operation of the spacecraft, including integration of scientific instruments, and for the Deep Space Instrumentation Facility which will provide post-injection tracking and data handling.

Common to the first two Ranger missions will be the following objectives: (a) engineering tests of the attitude-control system, solar and battery power supplies, communication equipment, and lifetime of components in the space environment; (b) scientific studies of the interplanetary medium—fields and charged particles, hydrogen, and dust. Both spacecraft will be placed in a high elliptical orbit with near-escape energy, and on the second occasion a lunar fly-by will be attempted.

The third, fourth and fifth Ranger craft will be used to attempt to land a survivable package on the surface of the Moon. Engineering tests of this, and of the mid-course guidance technique, are among the objectives of the mission, which also include scientific studies of the lunar surface and environment. The capsule will be used for



Ranger spacecraft configuration for the first two missions, in which scientific instrumentation is included but not a landing capsule. In overall charge of Project Ranger is the Jet Propulsion Laboratory of California Institute of Technology

seismology and the parent spacecraft for gamma-ray spectroscopy and photography of a small lunar area.

The designs of the two versions of the Ranger craft are as illustrated in the accompanying diagrams. In the third, fourth and fifth flights the scientific instrument superstructure is replaced by the rough-landing capsule. Jet Propulsion Laboratory has contracted with the Aeronutronic Division of Ford Motor Co for the design, development and operation of this capsule system.

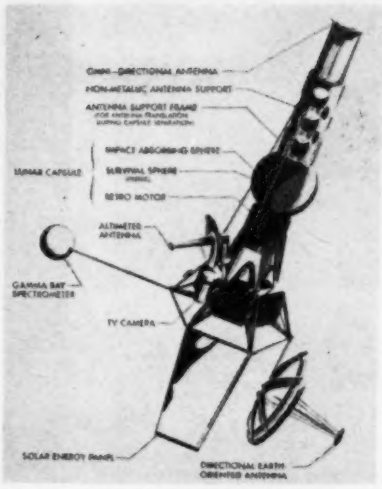
The 300lb capsule will separate from the spacecraft on a signal triggered by the altimeter when 20-25 miles from the surface of the Moon. A retro-rocket will decelerate the capsule to an impact speed of less than 300 m.p.h., while the spacecraft will be destroyed as it hits the surface at more than 5,000 m.p.h. The capsule will be protected by a spherical honeycomb crushable structure designed to absorb severe impact. The capsule's seismometer, temperature-recording devices and other instruments should transmit data back to Earth, all being well, for a month or longer.

Subcontractors to Aeronutronic on the capsule are Hercules Powder Co (retro-rocket) and Ryan Electronics Division of Ryan Aeronautical Co (altimeter).

The Ranger firings will take place during this year and 1962. In the period 1963-65 will come the next step—to attempt a controlled ("soft") landing on the Moon. Given the increased performance of the Atlas-Centaur vehicle compared with Atlas-Agena, it is intended to build a spacecraft which not only has the necessities of attitude control, power, and communications for the mid-course phase, but also incorporates a large controllable propulsion unit and a terminal guidance system. Much more elaborate lunar experiments will then be possible.

This soft-landing vehicle will be Surveyor, seven of which are at present scheduled to be launched by Atlas-Centaur during the 1963-65 period. Surveyor will weigh approximately 2,500lb when injected into its lunar trajectory, and 750lb on landing on the surface of the Moon. Of this 750lb, 500lb will comprise communications equipment, structure and temperature control devices, and the remaining 250lb will consist of scientific and engineering instrumentation.

As Surveyor approaches the Moon, television cameras will be switched on automatically and pictures of the lunar surface will be transmitted back to Earth. A large solid-propellant retro-rocket and three vernier rockets will be fired to decelerate the craft. After burnout of the retro-rocket it will be separated from the spacecraft and, with verniers still burning, the Surveyor will slow down to about 10 m.p.h. and land on the surface. The television system incorporates three upward-pointing and one downward-pointing cameras; above each of the upward-viewing cameras is a gimbal-mounted mirror capable of directing the television cone of vision through 360° of azimuth and from +15° to −45° from the horizontal.



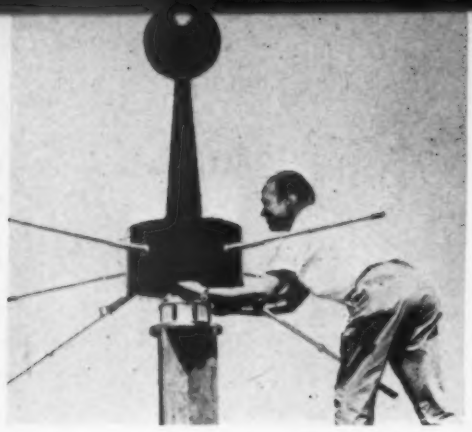
Revised version of Ranger spacecraft for third, fourth and fifth (capsule-carrying) missions

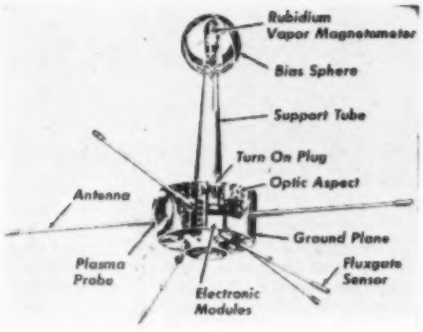
A drill will be extended from the spacecraft, designed to penetrate the surface to a depth of 18-60in. As it drills, small fragments of the Moon's surface and subsurface will be brought into the spacecraft and passed to different instruments for physical and chemical analysis. One of the television cameras will be used to monitor the drilling operation, so that scientists at the JPL Goldstone Tracking Station can study the performance of the system.

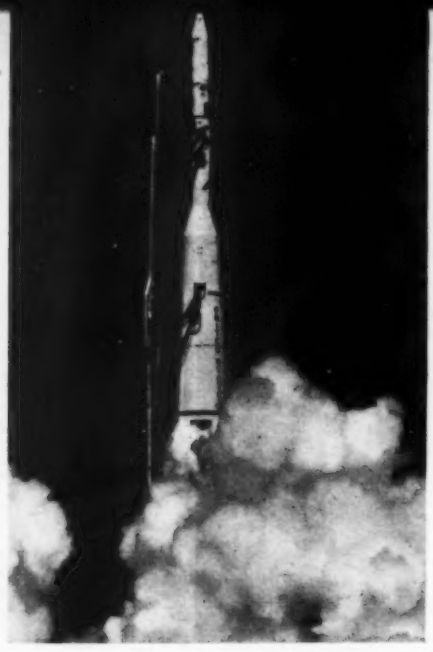
Other scientific instruments aboard the Surveyor will include a sensitive seismometer to record moonquakes or meteorite impacts, a sensitive magnetometer to determine whether the Moon has a magnetic field, instruments to measure lunar gravity, and instrumentation to measure radiation and the lunar atmosphere.

The Surveyor spacecraft, a mock-up of which is illustrated below, will be approximately 11ft high and will stand on three legs. The programme is expected to cost more than $50m, and under the technical direction of JPL responsibility for the complete spacecraft system design and operation has been contracted to Hughes Aircraft Co. Hughes was selected for contract negotiations by NASA on January 19, 1961.

Full-scale mock-up of the Surveyor spacecraft payload, seven of which are being built by Hughes Aircraft Co. On top of payload are solar panel and directional antenna; in foreground (above) is geophysical probe; at left in right-hand photograph are neutron activator and lunar drill







A three-stage Thor-Delta was used to launch NASA's Explorer 10 satellite into highly elliptical orbit on March 25 from Cape Canaveral. The 78lb package was designed to study interplanetary magnetic fields and solar plasma, and incorporated a sensitive rubidium vapour magnetometer

Missiles and Spaceflight . . .

A MINISTER FOR SPACE?

In the Commons on March 21 a private member's Bill "to provide for the establishment of a Minister of Space Research and Development; and for purposes connected therewith" was presented by Mr Woodrow Wyatt and read for the first time. In his speech Mr Wyatt said that he was proposing this appointment because he did not think that we should make real progress in this important new field until we had a Minister in the Cabinet with responsibility to co-ordinate everything to do with space. He claimed that the Americans were spending £3 10s per year per head of population on space development, the Russians "an equivalent sum" and the British not more than a penny per head.

Mr Wyatt's Bill, published on March 28, quoted a salary "not exceeding £23,750" per year for the Minister. His functions would be to co-ordinate, promote and carry out arrangements for space research and development.

HIGHER THRUST FOR SCOUT

An increase in payload capacity of some 40 per cent for NASA's Scout is planned under a joint NASA-Navy project to develop improved-performance third-stage and fourth-stage rocket motors for the launch vehicle. These improvements will be effected by replacing the current solid fuels with improved propellants similar to some of those now used in Minuteman and Polaris motors. Only minor design changes to the existing Scout motors will be required. The improved versions of the two stages are expected to be ready for use on Scout early next year, and the total cost of the programme is estimated to be $1,350,000. Development will be carried out at the Bureau of Weapons' Allegany Ballistics Laboratory in Cumberland, Maryland.

MORE BIG-BOOSTER STUDIES

Three contracts have been awarded by the National Aeronautics and Space Administration for comprehensive studies of possible future space vehicles beyond the Saturn class. The three contracts, each concerned with rockets with a first-stage thrust of 6m to 12m pounds, go to Convair, Lockheed's Georgia Division, and North American Aviation.

Representative and promising hypothetical vehicles are being studied. Some of the vehicles combine solid and liquid chemical fuels and others use liquid chemical and nuclear propulsion. Among the aspects considered are the optimum use of nuclear propulsion in large rockets; recovery and re-use of large space vehicles; large high-energy liquid hydrogen/liquid oxygen first-stage booster; solid and liquid fuel in first-stage booster; conventional tandem staging versus parallel staging; and pressure-fed versus pump-fed systems. The most promising configurations will be selected for further study.

MORE DYNA-SOAR DETAILS

Further to the news (published in *Flight* last month) that the USAF Dyna-Soar hypersonic glider has a third stage of propulsion, it is now clear that many different booster systems are under discussion. The original project was for the first few shots to be boosted by both stages of the Titan 1 ICBM, and Martin received a contract to this end. Titan 1 was chosen purely because of its convenience and reliability, but it cannot achieve the burnout velocity needed for orbit. Earlier this year Titan 2 was substituted (*Flight*, March 16), yet—according to Mr J. R. Dempsey, manager of Convair Astronautics—even this combination can only put 8,000lb in an 80-mile orbit. According to *Aviation Week* the present research glider has risen in weight from about 9,000 to almost 11,500lb, although progressive refinements are now reversing this trend.

ANOTHER LITTLE JOE

An additional Little Joe flight test of a production Mercury spacecraft will be made from Wallops Island, Virginia, following the March 18 attempt in which the test objectives were not achieved. The purpose of the test was to check the performance of a production Mercury spacecraft and its escape system during an escape manœuvre initiated at the highest air loads anticipated during an Atlas launch for orbital flight.

On March 18 the escape rocket apparently fired prematurely, resulting in improper sequencing of other systems. A ground command signal was used to effect capsule separation. Several shingles on the spacecraft were damaged in the test, but the capsule is in good general condition and will be re-used in the next Little Joe test.

The Australian Minister for Supply, Mr Alan S. Hume, officially opened the NASA Project Mercury tracking and command station at Muchea, Western Australia, on March 24.

Belling & Lee Ltd have been engaged by Sir Alexander Gibb and Partners, consulting engineers acting for the Air Ministry, to assist in the design and implementation of RF shielding and interference suppression at Fylingdales. Such protection must be provided not only for the BMEWS personnel but also for electronic equipment and computers.

According to the London *Daily Telegraph*, Lt Col Roy Roberts, of the USAF Air Research and Development Command at Holloman AFB, believes that "certain corridors" across the US should be evacuated for live missile tests "to find out what an enemy missile attack would be like." He asserts that the Soviet Union has been doing this over their own land-mass, and "apparently have no morale problem."

Ampex have been allowed to say a little more about the very advanced data recorder which flies with the Minuteman ICBM. The FR-600 is a solid-state transistorized package, in which FM-FM has been completely replaced by digital PCM (pulse code modulation). Several hundred channels can be sampled and recorded over a bandwidth of 500 kc/s at 120 in/sec tape speed. At 60 in/sec information can be transmitted at the rate of 350,000 bits/sec.

Although almost 100 Atlas vehicles have been fired, in both ICBM development and space launchings, the latest E version, with 389,000lb take-off thrust, has recorded four failures out of the first five shots. The fifth firing took place from the Cape on March 14, at 11.17 p.m. local time, and resulted in premature cut-off of the sustainer and an impact well short of the target area. Another malfunction resulted in a TM-76B Mace winged air-breather crashing into the Atlantic only a few seconds after leaving the Cape on March 28. This was the first disaster in 22 Mace firings; and last week it was announced by the USAF in Tokyo that Mace will be emplaced on Okinawa.

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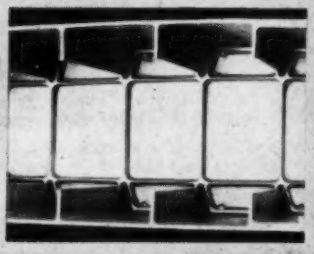
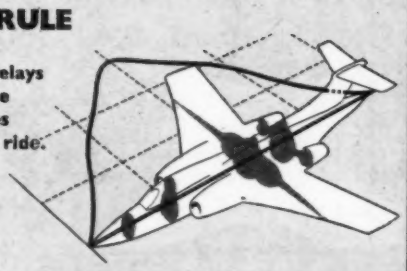


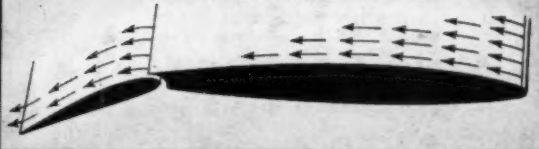
AREA RULE

Area rule delays the drag rise and provides a smoother ride.

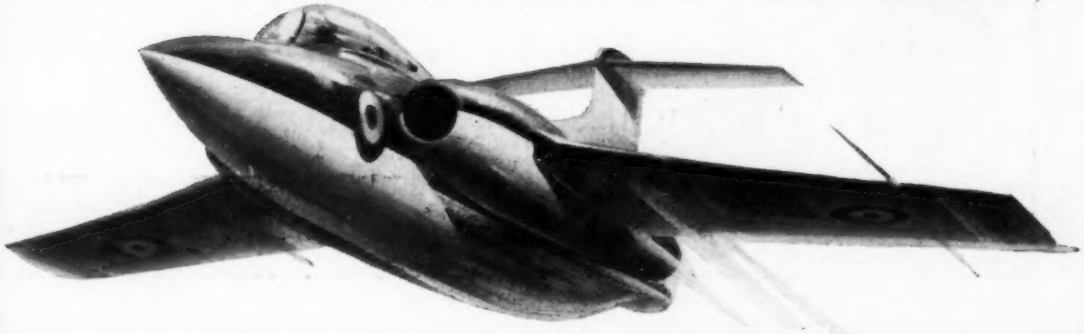


BOUNDARY LAYER CONTROL

Boundary layer control reduces landing and take-off speeds whilst maintaining full control.



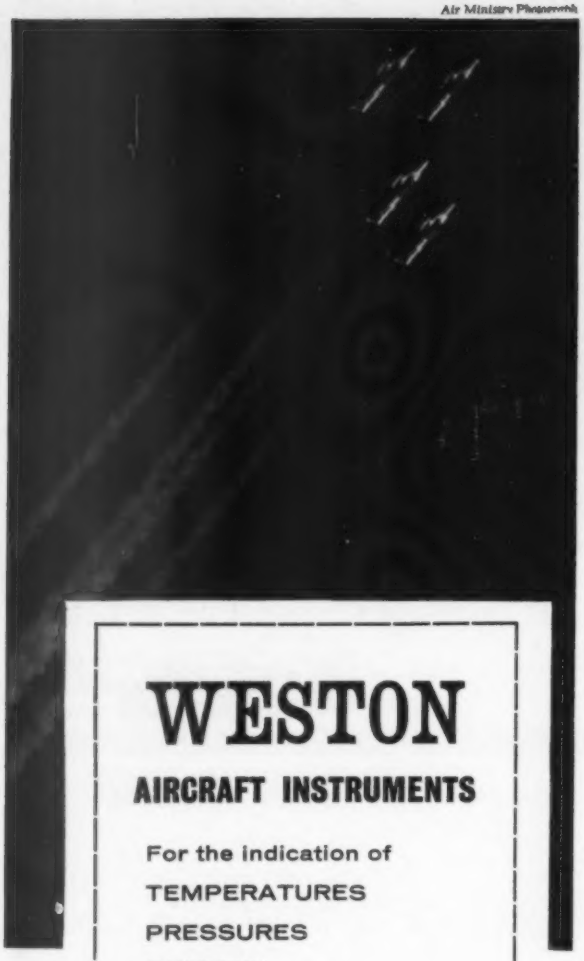
THE BLACKBURN BUCCANEER



strikes at "zero" feet beneath an enemy's radar defences

HAWKER SIDDELEY AVIATION

Air Ministry Photograph



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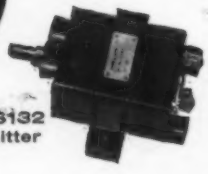

*Model S132 Transmitter

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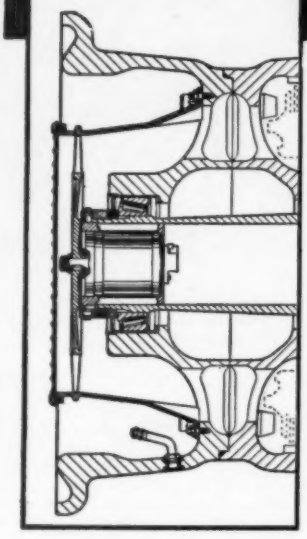

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THE SUPERSONIC TRANSPORT

Dr A. E. Russell's Lecture to the Guild of Air Pilots and Air Navigators

ONE of the most important papers of recent years was that delivered on March 28, before the Guild of Air Pilots and Air Navigators, by Dr A. E. Russell, CBE, DSC, FRAeS, FIAS, technical director of Bristol Aircraft Ltd. Special importance attaches to the lecture by reason of the fact that Dr Russell is popularly regarded as the master mind behind the British supersonic airliner project, for which British Aircraft Corporation have a Ministry of Aviation study contract.

The prospect of a supersonic transport—said Dr Russell—has had to await an advance in the field of aerodynamics and the awakening of interest by an authority able to find large sums of money in support. Arguments in favour of such a project vary from an emotional complex of national prestige to claims of economic merit and the consequent inevitability of such developments emerging around the end of this decade. In some unexpected places, judgment seems to be dominated by over-emphasis on the merits of the highest conceivable speed.

Starting with a wide open field, it has become apparent that two sharply diverging tracks are being set, the followers of which tend to be recognized by their nationality. Many on the one side are puzzled by a strong indication that the other advocates a cruising speed around M3. Nobody denies that M3 poses formidable technical problems; but these need not be regarded as uncrossable barriers. The present point at issue is whether such effort is worth undertaking, for a less ambitious speed seems to offer a considerably better chance of approaching typical costs in airline operation. Alternative subsonic transport provides the standard of reference.

It is well known that there is an inevitable sharp drop in lift/drag ratio in the neighbourhood of M1. Aerodynamic solutions now available limit this drop to approximately half the value achieved by the best subsonic aircraft. Thereafter the continuing fall with increasing Mach number is very gradual. Fortunately, with increasing speed the propulsive efficiency rises (Fig 1), so that—in spite of the higher drag—the overall efficiency first falls sharply at M1 and then rises again with increasing Mach number.

With rising speed a complication to be faced is the rapidly increasing generation of heat, for which there are two fundamental causes. In the first place, the forward motion of the aircraft compresses the air by impact, the areas most affected being the leading edges and engine intakes. The second effect is the exchange of heat from the layer of air to which energy has been transferred by friction, by contact with the external surfaces.

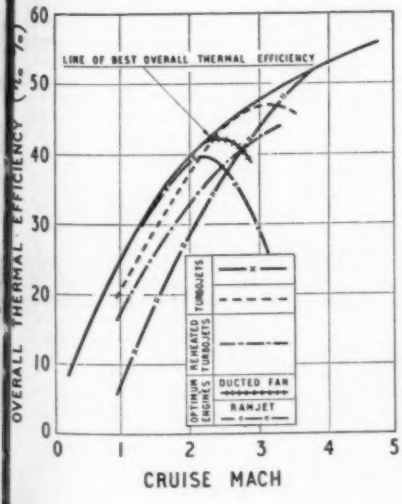


Fig 1. A plot of overall powerplant thermal efficiency over a wide range of cruising Mach numbers. The improvement with increasing Mach number counteracts the reduction in lift/drag ratio

Choice of Engines

Typical results show that, whereas up to about M2 the turbofan should have a higher efficiency than the comparable turbojet, at somewhat higher speeds this advantage is reversed. As speeds continue to increase, the higher temperature in the intake reduces the allowable pressure rise in the compressor, and after passing through a hybrid form the most efficient engine eventually becomes a ramjet. While it is essential that the engine performs efficiently in cruise, it must also be as economical as possible at lower speeds and at the lower altitudes through which it must pass and, on occasions, have to loiter. Generalities may therefore be unreliable, so comparison should be made on the basis of specific engine designs which have passed through successive adjustment to achieve the best overall compromise.

An example can be quoted where a turbofan and a turbojet, each employing reheat only for transonic acceleration, have been carefully matched to suit an aircraft having a cruise speed of M2+. An optimum overall cost analysis, taking into account the effect of variations of the diverse factors affecting aircraft operating economics, led to the choice of a turbofan having slightly less cruise thrust than the turbojet. Consequently the cruise altitude was somewhat lower and the climb fractionally slower. With a large turbofan and accompanying higher installed weight and drag the trends showed increased operating costs. For a sector distance of 3,000 n.m. (zero wind), the best results showed that an equal quantity of fuel—37 per cent of take-off weight—was required by both the turbofan and turbojet.

In establishing the total quantity of fuel that must be carried it is necessary to decide what reserves are required. At present, this approaches an arbitrary choice based on the experience of individual airlines. Ideally, a rational basis would be used, making due provision for the probability of occurrence of all possible adverse events. Generally, an attempt is made to take account of engine and airframe deterioration, engine failure en route, navigational errors and air traffic control requirements.

As regards engine failure, an analysis has been made, for six-engined supersonic aircraft, of the available range remaining after single or double engine failure at any point on the North Atlantic routes. Comparison with a similar study for a four-engined subsonic aircraft shows that the same airfields are as readily within reach in both cases. The same proportions of fuel reserves to cover engine failure should, therefore, be adequate. Winds, either head or cross, cause progressively less deviation from the desired track as aircraft speed increases, and improved navigational systems are continuously being developed. Current methods of valuation of the allowances in the foregoing respects should be more than adequate. Should circumstances impose a temporary reduction in the flight-plan altitude, then, for a given height loss, reserves are consumed at rather more than twice the rate of a subsonic aircraft.

Many contingencies are sometimes lumped together in the terminal holding reserves. It may be assumed either that the aircraft is held for 80min at 30,000ft or, alternatively, 45min at 20,000ft and 15min at 5,000ft, with a 200 n.m. diversion. The equivalent reserves would then be 20 per cent (turbofan) and 21 per cent (turbojet) of the fuel consumed on a normal 3,000 n.m. flight. With an additional allowance for de-icing, this leads to the total fuel to be carried being equal to 44.7 and 45 per cent of the take-off weight, the small advantage resting with the turbofan.

Overall powerplant efficiency in a supersonic aircraft is greatly dependent on the design of the variable intake and exit nozzle. As the range of operating conditions is very wide, this leads to complex arrangements. The intake must control shocks at the lips and throat, and pass the appropriate mass flows through a long diffuser. Subsidiary vents are necessary to augment or spill, according to the main-intake capacity and the needs of the engine. The condition

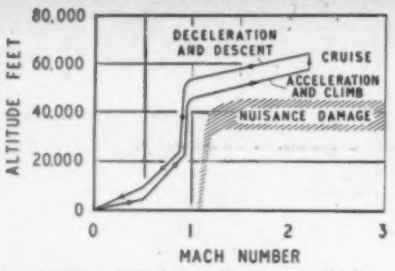


Fig 2. Typical flight profile for an M2.2 airliner, the ratio of Mach number and altitude being chosen to provide optimum economics and minimum disturbance on the ground

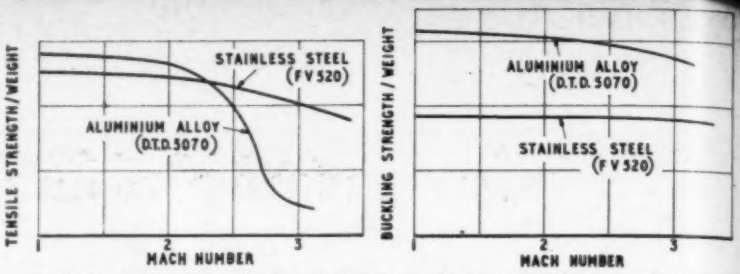


Fig 3. Comparative curves for typical aluminium alloy and stainless steel: left, strength/weight ratio after prolonged soaking at the Mach number indicated; right, curves showing the improved buckling strength of the less-dense material

THE SUPERSONIC TRANSPORT . .

of the air in the intake closely approaches stagnation temperature and pressure, while at the engine exit the jetpipe contains reheat equipment, primary nozzles, ejector reversers and variable final nozzles.

Noise levels established by modern engines, and imposed upon a suffering public, are probably near the limits of endurance. Fortunately, except in the immediate proximity of the aircraft, it does appear that with supersonic airliners life will be a little less disturbed. On the runway itself, the sound pressure level will be only 2 to 3db higher than that from existing subsonic jet aircraft. Immediately after take-off the noise will be no worse, and by the time the four-mile point after start of roll has been reached, it should be possible, while climbing on a gradient of just less than 5 per cent, to meet the limit suggested for night operation (quieter than present long-range jet aircraft). This result is rendered possible by the substantial reduction in required thrust, following high axial acceleration from take-off to the aircraft minimum-drag conditions. With a low aspect ratio, this technique is better for minimum ground noise than climbing at the maximum rate.

As portrayed in Fig 2, the climb is carried out at a constant speed of about 400kt EAS to 25,000ft, at a rate of 10,000ft/min. Beyond this stage the speed is held to M0.95 until about 40,000ft is reached, by which time the combination of altitude and angle of flight path should allow transonic acceleration to take place without objectional ground sonic booms. Cruise speed is reached at just under 60,000ft, the aircraft having covered more than 500 miles in just over half an hour. In the next 2,000 miles the aircraft climbs 6,000ft. On the descent, the flight-path angle is unfavourable towards the prevention of ground sonic booms, so that it is probable that transonic deceleration will need to be carried out fairly shortly after initial let-down.

For a cruise at M3, the range of engines investigated included turbojets of various pressure ratios and maximum cycle temperatures, both with and without reheat (this device is confined to high altitudes). Also, besides reheated tubofans, a combination turboramjet was considered, since it has been shown to have interesting possibilities, and a study [*Flight*, June 19, 1959—Ed] indicated a lower engine-plus-fuel weight than any other. It is unlikely, however, that such a radical departure, using principles untried in like applications, could be adopted for a supersonic airliner.

At M3 the highest propulsive efficiency is offered by a turbojet of medium pressure-ratio and high turbine entry temperature. As speed rises, the varying design conditions throughout the flight range become increasingly incompatible. It might be assumed, therefore, with cruise fuel accounting for only about half the total, that some sacrifice in maximum propulsive efficiency will produce the best overall results. In flight conditions away from cruise and requiring less than full thrust, lower consumption is obtained with a smaller engine running at relatively high power. Such an engine would need reheat to meet thrust requirements in the latter half of the climb and in cruise. In the case of turbojets this solution has very limited scope, since the take-off noise limitation defines a minimum value of unreheated static thrust. A greater advantage in this respect is available to turbofans, with their inherently higher thrust at low speeds.

After similar treatment to that for the M2.2 case, fuel and powerplant weights have been derived and are shown in Table 1, p. 457. It would be remarkable if a similar investigation carried out by a different technical group produced exactly the same figures. Extensive measures have been taken to obtain consistency, and comparisons have been made with all available sources of relevant information. Where discrepancies have been found between the values shown and the results of other studies, the differences usually increase the gap between the two Mach numbers. Others more closely balanced can be explained by a too-generalized approach—using, for example, the Breguet formula instead of a complete flight survey.

Structure and Systems

At M2.2 the stagnation temperature is 155°C (310°F). Heat is transmitted from the boundary layers so that the structure reaches a temperature of 120°C (250°F) away from the leading edges. In this environment, the requirements for a structural material to provide the necessary integrity with long operational life can generally be satisfied by the use of appropriate aluminium alloys. Only local areas subjected to stagnation temperatures require the application of stainless steel or titanium.

Critical comment is sometimes heard that development of an M2.2 aircraft to higher speeds is blocked. The premise is true, but the inference is irrational if it is assumed as a foregone conclusion that faster aircraft carry no penalties. The circumstances are similar to those of the past and of the present. Few, if any, airliners have enjoyed a built-in potential for a subsequent speed rise.

As before, the struggle is to achieve the highest possible payload by balancing the conflicting claims of aerodynamics and structure weight. The comparatively small difference between two large numbers, which prescribes the payload of a supersonic transport, demands that the shape of the aircraft be matched as closely as possible to the prevailing conditions. Consequently it should be expected that an aircraft designed for M2.2 is readily identified visually from one designed for M3. It can have a narrow delta wing of sufficient thickness and volume to contain the fuel and main landing gear. Wing loading should be chosen to allow a close approach to the maximum lift/drag ratio when cruising at some 60,000ft. The advantage of wing fuel stowage is facilitated by a simple device which prevents a free exchange of heat from the surface to the fuel, so that the fuel can perform adequately as the main heat-sink for the air-conditioning system.

Detail arrangements of the main structure follow conventional practice, and constructional problems are not severe. Most aircraft have features of particular interest to specialists, and also to those members of airlines suffering under the task of having to maintain them in service. For the time being, it is sufficient to regard the M2.2 structure and systems as no more complicated than those in current use.

After adding all the weights, 10 per cent remains available for the payload, various associated operator's items and the crew. If the number of passengers is arbitrarily taken to be, say, 120, then the gross payload is 28,500lb, with operator's service items 3,500lb. A flight crew of six, with their baggage (1,700lb), gives a total of 33,700lb. The corresponding aircraft take-off weight is now readily obtained.

The narrow delta wing-form appropriate for the M2.2 aircraft becomes unsuitable at much higher speeds. Increased leading-edge sweep leads to a very low aspect ratio. Without complex auxiliary devices, excessive area is required for acceptable approach speeds, and very high installed thrust is needed in order to fly close to the point of maximum lift/drag ratio. Research and analysis has not yet reached a point where the best aircraft configuration can be picked out for an M3 airliner. The shape most generally favoured appears to be a canard, whose delta main wing has moderate sweep and very low thickness. A substantial amount of fuel must be stowed in the fuselage.

When cruising at 70,000ft at M3 the structure reaches a temperature of 275°C (530°F), and a complete switch to stainless steel or titanium is necessary. Two different types of structure must be considered, one resembling the familiar skin and stringers and the other some form of honeycomb sandwich.

An immediate conflict appears. As the density of structural materials increases then, for the same weight, skin coverings and reinforcing members must be made thinner. But where local strength and stiffness is important (as it obviously is over extensive areas) a thin member, in spite of its higher intrinsic strength, buckles more easily (Fig 3). Consequently, additional supporting members, which do not themselves contribute directly to strength, must be provided to stabilize the main members. This parasitic weight degrades the structural efficiency; and this leads either to a drop in payload or, alternatively, to a larger and heavier aircraft for the same job.

This disadvantage can be overcome only by fully supporting the load-carrying skins by a sufficiently stiff and light sandwich core. Such a solution is unfortunately very expensive, particularly in areas of double curvature, costing several times as much as conventional structures. It is probable, however, that an airframe built

(*Concluded on page 457*)

FLIGHT SYSTEM SURVEY

Joint-user Airways

It is significant that Killard Point is a name now equally familiar to pilots of civil airline 707s, Vulcans and Victors of Bomber Command, Lightnings on test from Warton, and RB-66s and other USAF aircraft using the Jurby (IoM) bombing range. All these types, and many others, have occasion at some time to use the facilities provided by this radar installation on the County Down coast of Northern Ireland; but it was with particular reference to upper-airspace control that a visit was recently arranged by Air Ministry to Bishops Court, the parent RAF station for Killard Point, briefly described in *Flight* last week (page 392).

Bishops Court is one of three air traffic control radar units operated on a joint RAF/MoA basis to provide control for military and civil aircraft in the upper airspace (above 25,000ft) over the United Kingdom. The other units are at Hack Green, near Nantwich, Cheshire, and Sopley, near Christchurch, Hants. They are on an operational trials basis and are to be augmented in the near future by two further stations, one in the north-east (possibly at Bulmer) and another in the south-east, so that coverage over the United Kingdom will be comprehensive. It will also form part of Eurocontrol, whose representatives have visited Bishops Court.

Its installations consist of the Killard radar unit and the wartime RAF airfield Bishops Court, now on a care-and-maintenance basis, where most of the 250 Service personnel are accommodated. (There are about 50 civilian staff at the station.)

The significance of Bishops Court is threefold: the employment of what was originally defence radar for ATC purposes; setting-up of a civil/military control available to all users of the upper airspace; and the station's situation, astride one of the main trunk routes for jet airliners passing between London or the Continent and America. Its horizontal radius of 180 miles gives it a control area from longitude 10° W (eastern boundary of the North Atlantic Control Area) to the Greenwich Meridian in the east, from Latitude 57° N in the north to 52° 30′ N in the south. This area covers Northern Ireland, the Lowlands and Southern Highlands of Scotland, Northern England, the Irish Sea and North Wales, and the North Atlantic approaches to the UK.

The services of Bishops Court are available to any aircraft at any time. Chiefly, they exist for control of the above-airways airspace which was once free for military traffic, but which since 1958 has been increasingly bitten into by civil jets. This kind of surveillance is being extended not only more widely, but also downwards from the 25,000ft level. Bishops Court's other functions, referred to initially in general terms, include the surveillance of military and MoA aircraft on the Jurby and West Freugh (Mull of Galloway) bombing ranges and test flights within its area.

Air Cdre H. J. Hickey, AOC UK Air Traffic Service, described the Bishops Court control as "an integrated civil-military service." In *Flight's* description last year (August 19) of the development of airways control over Britain, it was stated that "current official policy is that there is no need for a unified civil/military system . . . as . . . postulated by the FAA in America but . . . a kind of separate togetherness is being practised." At Bishops Court, there is quite a lot of seeing what a little togetherness will do; as Air Cdre Hickey explained, the fact that it is an RAF station is "coincidental." The question of what it all costs, and who pays, is not clear. AVM Sir Laurence Sinclair, Controller of Ground Services at the MoA, would not or could not say; but he indicated that the controversial landing fees at London Airport covered much more than the provision of a runway. Whatever the cost, with increasing high-level civil traffic, surveillance of the upper air routes is not only desirable but necessary.

H. W.

Operations room at RAF Bishops Court, ATC unit on the Northern Ireland coast (see above). Service and civilian controllers work side by side

Intercom for the Belfast

An order worth £40,000 has been placed with Ultra Electronics Ltd for the supply of UA.60 intercom equipment for the ten Short Belfast heavy freighters for the RAF. The UA.60 system provides for intercom service at crew stations and allows selection of various receiver and transmitter channels by individual crew members.

AWA-Brush Partnership

A partnership has been formed by the electronics sections of Armstrong Whitworth Aircraft Ltd and of Brush Electrical Engineering Co Ltd, known as Armstrong Whitworth/Brush, to manufacture and market advanced electronic and electrical control and intelligence systems. Brush will be the trading organization for the new partnership and will work in close co-operation with the sales staff of Armstrong Whitworth Equipment. Through Armstrong Whitworth/Brush, enquiries for electronic equipment will be channelled to whichever of the two companies has the most suitable facilities. The new partnership has already received two contracts, one for data link equipment for a radar installation, the other for recording equipment for experiments in the detection of underground nuclear explosions.

Tactical Simulator for the Argus

Nearing completion at the Montreal factory of Canadian Aviation Electronics is a tactical crew procedure trainer for the Canadair Argus. Built into the test fuselage section originally made for fatigue trials, the trainer reproduces the crew stations and operation of all the anti-submarine equipment in the Argus, including radar counter-measures receiver, magnetic anomaly detector and sonobuoy gear. Twelve tactical crew members are catered for, the aircraft flight simulator for pilots being a separate system. The fuselage section with its internal equipment is surrounded by about 30 cabinets and consoles at which instructors can introduce targets into the simulator. The crew can be monitored while they detect, classify, locate and finally destroy the targets.

Speech Compression by Vocoder

Two devices intended to transmit speech for better intelligibility or over a narrower band-width have been produced by Hughes Aircraft Co. Called Vocoder, the device eliminates those sounds in human speech which are not essential to the understanding of the words and transmits the basic sounds for reconstitution at the receiver. In this way only 325c/s instead of 3,000c/s of band-width are occupied and additional communications frequencies could be made available. The speech-compression device works on analogue principles, but Hughes have also developed a digital version of Vocoder, the transmissions from which occupy the same band-width as normal speech but result in more intelligible reception.

Studies have shown that vowels are predominant carriers of information in human speech, while consonants give speech the characteristics which make it possible to distinguish one person's voice from another. Vowel sounds consist primarily of harmonies of the frequency at which the larynx vibrates, normally in the range of 70 to 250c/s for men. Consonant sounds have no definite harmonic frequency pattern, being composed of frequencies distributed at random throughout the spectrum and varying in amplitude according to the sound being produced.

The Vocoder, developed under Wright Air Development Division contract, separates the voice sounds into 12 different frequency bands. Pitch information is carried in a 13th channel. A digitizer converts the signals into a serial bit stream of binary data for transmission; and it is reconstituted into 13 channels and passed to a synthesizer at the receiver. The sounds are produced by a "buzz" generator for vowels and a "hiss" generator for consonants. The band-width used is 3,000c/s and the unit weighs 375lb. It contains 335 silicon transistors, 79 germanium transistors and 1,325 silicon diodes. A smaller airborne version has been produced.

Right, "Rolls-Royce" 707 G-APFI, the proving flight aircraft, at Kindley Field, Bermuda. Below, steep take-off from Kindley

PERUVING FLIGHT

By Mark Lambert

UNDOUBTEDLY the best way to travel over long distances is by big jet airliner—and the best way to experience big-jet travel is, to my mind, a "round-the houses" proving flight like the one I have just accompanied. With their "Rolls-Royce 707s," BOAC have made proving flights west-bound to Hong Kong, east-bound to Teheran and, on this third flight, south into the Caribbean and down to Lima, Peru. The 707 route network is now being greatly extended and next Tuesday the first of the direct services to Lima will begin, re-establishing an Anglo-Peruvian link which was broken by BOAC in April 1951.

BOAC's fifteen 707s are already flying services to New York, with extensions into the middle west at Chicago and Detroit; to Hong Kong *via* San Francisco, Honolulu and Tokyo; to Los Angeles non-stop; and from New York to Bermuda. The new Lima service will be twice weekly in each direction, flying a through service *via* New York and Nassau. The total distance is just over 7,000 miles and the outward flight will take 18hr 20min elapsed time, although the difference between local departure and local arrival time will be 12hr. 20min. The return trip will take 17hr 15min.

The 707 cabins are laid out for 32 first-class passengers four-abreast forward and 97 economy class six-abreast in the rear; and separate galleys and cabin staff attend the two groups. Economy service is good: first-class service is almost unbelievable, with some little touches of exotic luxury which really add to personal comfort rather than merely filling the overnight bag with odd trinkets. BOAC certainly takes its reputation for service very seriously. After each sumptuous first-class meal—and there seems to be an endless succession of them—each passenger receives a very hot, damp face-towel with which to mop his brow. A Japanese idea, this, but surprisingly effective if one accepts that a fine meal taxes one's resources a little. The seating is extremely comfortable, the décor restful and the small but closely spaced windows provide a surprisingly good view. Flying high and fast, the journey-time is short and one may see little or nothing of the ground below: a complete climatic or geographical area may slip by unnoticed. To cram eight hours of time difference, longitude-wise, into a nine-hour flight may be hard on the passenger's system, but it is infinitely preferable to a long, noisy haul at half the speed.

Still further extensions of the 707 network are in prospect. A London - Washington service, calling alternately at Boston or New York, will come in June; and the same month will see a London - New York - Barbados - Trinidad route. Later in the year Bogota will also be served, on a separate route *via* Bermuda, Trinidad and Caracas. During the summer of 1962 BOAC hope to extend the Lima service down to Santiago, Chile, to link up with the existing Comet service *via* Africa and the eastern states of South America. Any new service into South America is an important flag-carrying operation and a very useful business service—and the holiday potential of that continent, already high for Americans, is looming large for British travellers. These new routes should raise 707 utilization from 6½hr to 10½hr per day and will require apron turn-rounds at London Airport. Some 52 services per week will leave London.

The proving flight which this account concerns was logically aimed at investigating operating conditions and familiarizing crews for most of the new services to be introduced this year. We started from London Airport with perhaps 50 people on board, including 11 BOAC captains, two engineers, two first officers, one navigator and one pilot navigator. Among the captains were Capt J. T. Percy, senior pilot of BOAC; Capt T. Nisbet, flight manager of the 707 flight; and Capt Alderson, BOAC's technical manager.

The flight, in aircraft G-APFI, was numbered JPF 024 and took off from London weighing 128,400kg at an unstick speed of 161kt. Capt Nisbet was in command, and we made Bermuda, cruising for most of the time at 35,000ft, in the record time of 6hr 52min. Our route took us north of weather ship *Juliet*, south of *Charlie*, and through 47°N 50°W, quite close to St. Johns, Newfoundland.

Bermuda, a collection of more than a hundred islands, small and large, has average temperatures ranging from 67° in February to

Below left, modern Spanish colonial architecture in a residential suburb of Lima. Right, the ultra-modern sailing club headquarters on the Pacific at Callao, almost on the outskirts of Lima. The bathing season is just ending

Left, Braniff handle BOAC at Lima. *Right, Lima International through the morning haze.* *Below, typical scenery in the Cordilleras, north of Lima*

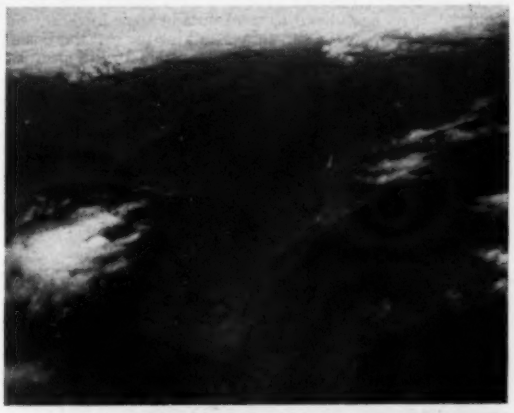
86° in August. The sea is a startling pale blue, the vegetation a crisp sub-tropical green, the local atmosphere British shop-window and the visitors 99.9 per cent American—in Bermuda shorts. Kindley USAFB, at the east end, was full of KB-50J tankers, RC-121 radar pickets, T-29 navigation trainers and a cross-section of transports. The civil terminal is tucked away at one end of the airfield.

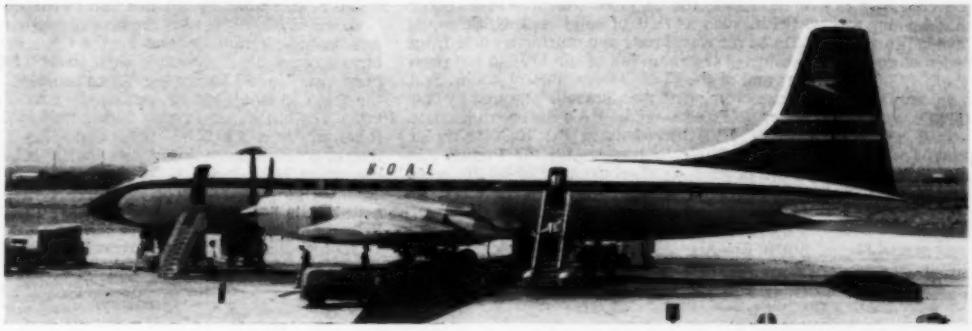
If Bermuda is a tidy step from Heathrow, Lima is an even tidier one, but our flight time was very little longer. We took off in the morning, Capt Cracknell in charge, and made the 900 mile dog-leg to Nassau in order to join the standard airway route across Cuba, Jamaica, Panama and on down the South American coast, past Cape Mala, Esmeraldas, Salinas (Ecuador) and Talara in Peru. It is mostly a VHF route for communications, a frequency of 126.9Mc/s being almost universal, with NDBs for navigation. Towards the south, the aids tend to be privately owned by airlines, rather than provided by the State, and there are some gaps in VHF coverage. The route follows the coast in order to avoid the turbulence of the mountainous areas, where many of the peaks tower up to 20,000ft.

From the air the Caribbean is a splendid blue, curled with coral reefs and colour-patterns like cream half-mixed in fruit syrup. The cu-nims rise with the morning sun and tower to 707 cruising heights—and they are so rough that local operators stop flying at night when such weather is about. In six minutes we crossed the Panama isthmus—near the canal, the captain remarked, and some of us made out the Gatun lake. Then the Pacific stretched away, infinite and grey, as we headed across for Esmeraldas in north-east Ecuador. We saw some of the coast through gaps in cloud; and the cu-nims continued to tower far on our left, but now marking some of the first of those peaks. Minutes after Esmeraldas we crossed the equator, trying to feel as if we were really changing from winter to summer, but the air conditioning stayed the same and no one could think of anything commemorative to do in time.

Some 50 minutes later we had passed Ecuador and caught our first sight of Peru. I had expected lush coastal plains nestling in the lap of the Andes, but from Talara, on the edge of the Lima FIR, for 560 miles down to Lima itself there was little but brown desert. There were flourishing oil wells, too, but we could not discern them. Occasionaliy, jagged patterns of violent green marked irrigated and fertile land in some of the valleys. Elsewhere veritable glaciers of gravel lay poured down steep valleys. Farther to our left, still the giant saw-blade of mountain peaks.

BOAC is represented in Peru by the Pacific Steam Navigation Co and handled by Braniff Airways. The latter company therefore





Above right, the passenger hall at Seawell Airport, Barbados. Right, the Britannia 312 preparing to depart from Barbados

PERUVING FLIGHT . .

take BOAC company communications traffic, switch on their private NDBs and provide ground services at Lima. From 35,000ft, VHF radio can reach perhaps 240 miles, but there is none in the north and HF has to be used until in range of Lima. Most of the airways are marked "uncontrolled airways" and 126.9Mc/s is still a virtually universal frequency.

Lima's traditional airport is Tambo, but this has been superseded for international flights by the new 11,500ft runway, with its four high-speed turn-offs, at Lima International. Here there is runway lighting and a rotating beacon on top of the little control tower. The terminal building is small, especially when two or three jet flights come in together, but ground has been broken for a large terminal and a dual carriageway to Lima city appears to be built. Approach lighting is being installed and an ILS will also materialize in due course.

Peru has one of those even climates—maximum 85°, minimum 52° during the last 30 years. People are worried that it might rain this year and the condors are protected because they are useful scavengers. We were not told who would pay whom if a condor hit, or was hit by, a jet airliner. The apparently barren coastal plain is in fact alluvial soil 1,500ft deep and anything will grow so long as it is watered. Lima was watered and gorgeous in parts and could offer anything from ultra-modern skyscrapers, through Spanish colonial at its best down to mud huts at their lowliest. For some months of the year the sun shines and for the rest there is a permanent high overcast. There is also a tendency for low stratus to come in from the sea, making "goldfish bowl" visibility. But if Lima is weathered in, Pisco, about 150 miles to the south is usually clear as a diversion. No English is spoken on the radio there, so a telephone call will produce a green light for any jet airliner wishing to land. The other diversion is Talara, 560 miles, but only one hours' 707 flying to the north. The weather factor here is very good. Having assessed the situation and given two demonstration flights for local publicity, the crews could be said to be "accLimatized."

Two NDBs to Trinidad . . .

We therefore set out for Trinidad and Barbados. The first leg was only four hours, but it took us in across the Andes, past Mount Huascaran (22,200ft high) and out over the featureless green jungle of the upper reaches of the Amazon. For hours we flew over this jungle, out of Peru, across Colombia and into Venezuela, with nothing beneath us but plain green, relieved every now and then by a meandering king-sized river—part of the Amazon system which has a water surface area comparable with that of the Mediterranean. There were two NDBs, but one of them was switched off. At 1237hr we recrossed the equator at 70°W, in the Bogota FIR which is marked as "non-implemented." We began to feel the influence of the Caribbean again as broken low cloud gave way to big build-ups. Statues of cu-nim—some white, some brand X—marched past our windows and the Boeing shook in turbulence. Venezuela began to look inhabited as we crossed the stately Orinoco river at Ciudad Bolivar.

The clouds closed in as we let down across Trinidad and shortly before we reached Piarco Airport it began to rain. Below us were little stilted huts and bouquets of palms on a brown-green, tropical penny-piece agriculture. Hills like a short, steep sea and wet rags of clouds wringing out heavy rain. The steam heat struck our faces as we left the aircraft and, clutching the umbrellas brought to us, ran through the streaming rain. Soon, we were drinking ice-cold planter's punch in the Bel Air hotel. Had the Peruvians really worried about rain? Or did that all happen the day before last year?

. . . And on Crowded Airways Home

The aircraft was refuelled and we set off for the 187 mile hop to Barbados. Before the engines started it was oppressively hot in the cabin, but BOAC produced ice-cold damp face-towels sprinkled with scent, and little Japanese fans—the most refreshing treatment imaginable. Before the towel was warm, the air-conditioning had taken over and all was cool and smooth again. Our cruising height for the crossing was 24,000ft but we stayed there for seven minutes before letting down again to Seawell Airport. The ground temperature here was 80°, the atmosphere not as steamy as at Trinidad and the sea was rushing in small waves against the wall beneath the hotel terrace, as two West Indians gently sang calypsos over our planter's punches.

London to Bermuda was a change of several hours and a brief meeting with warm sea tropical vegetation. Lima was a short expedition into the monoclimatic zones, a nod at the 29 distinct Indian civilizations which culminated in 14 dynasties of Inca rule and the Spanish colonial régime, and a gasping footstep or two on the 16,000ft mountain roads. From this we fell into the steaming cauldron of Trinidad and halcyon *laissez faire* of Barbados, from the quick lift of the Pisco sour cocktail of Peru to the stunning blow of the planter's punch in the Caribbean. The change could only be equalled by the long haul home *via* last word in modern civilization, New York. While we stacked for half an hour in the Lido holding pattern for Idlewild we saw 12 jet airliners in our immediate vicinity, all flying in different directions, climbing or descending. It took a mere half-hour to process us into the transit lounge and notify us that we came from a plague area. A dreamy flight home with a night's sleep in the first-class compartment of a Britannia 312 proved to be another version of the ultimate in civilization, especially after a BOAC dinner.

The hard-working efficiency of our world is an ocean away from that world of privately-owned NDBs and non-implemented FIRs, but the "Rolls-Royce 707" links them so fast that the change from one to the other can prove quite a shock to the system. A 707 landing with spoilers and reverse thrust and braking looks fast, sounds noisy and feels rough, but one comes to accept it as the only incongruity in an otherwise magnificently smooth and comfortable form of travel. The return to a propeller-driven aircraft is something which only a lower fare could justify.

UNITED AIRCRAFT TODAY

SEVERAL disclosures on the work of its operating divisions are published in the report to stockholders of United Aircraft Corporation for the calendar year 1960.

Pratt & Whitney Aircraft: Development cost of the new JT8D-1 turbofan, powerplant of the Boeing 727, is estimated at $75m. A substantial part of this will have been incurred by the end of 1963, in which year production deliveries begin. This company-financed programme will account for a large proportion of total expenditure on development financed by the corporation as a whole, which rose from $28m in 1959 to $39m in 1960, and is expected to reach over $50m this year and about $60m in 1962. Most P & WA engines are government financed, but the little JT-12 (J60) turbojet was undertaken privately, and its development cost is being recovered by a levy on its sales to the US Government. On the other hand, entry to new fields, such as that of solid rockets, demands expenditures which can be recovered only at a much later date from sales of developed products. Overhaul life of the JT3C-6 has risen from 1,000 to 1,600hr and of the JT4A-3 from 800 to 1,400hr. Sud contemplates an advanced version of the Caravelle powered by two JT8Ds, and last October SNECMA—P & WA's European licensee—ordered four JTF-10 (TF30) turbofans in the 10,000lb-thrust class for delivery in 1961. Under contract with the French Air Ministry, SNECMA will develop an afterburning JTF-10 "to meet the performance requirements of a French military aeroplane"—doubtless the Sud VTOL project mentioned in *Flight* for November 11. Last November the J58 turbojet successfully completed a 25hr test in a M3 environment (2,000 m.p.h.), and has possible transport applications.

Hamilton Standard: Intensive development continues on the variable-camber propeller, and on a propeller, control system and reduction gear combined in a single package; both developments are considered particularly applicable to the V/STOL field. Ham-Stan are responsible for both the environmental conditioning and air-inlet control systems for the B-70, and "the pace on these projects moved rapidly and well in the closing months of the year." The division has also developed "the most advanced autostabilization equipment yet conceived for helicopters"; it is in production for the Sikorsky HSS-2N.

Sikorsky Aircraft: Production of the S-56 ceased in 1960, with 156 delivered. Yet 1961 business should substantially exceed that for 1960, largely owing to increased production of the HSS-2, while current military contracts for the S-58 continue through 1962. Development of the twin-JFTD-12 S-64 crane has been accelerated, and the first should fly late this year or early in 1962.

Other divisions: Norden are now delivering the new search radar and terrain-clearance system for the Grumman A2F Intruder, and have successfully flight-tested their small (20lb) all-attitude inertial platform. United Technology Corp achieved complete success with the three 15,000lb test rockets of the new conical segmented type bought by NASA, and expect during 1961 to fire a 250,000lb version followed by a 500,000lb size. Canadian Pratt & Whitney put intensive development effort into the 500 e.h.p. PT-6 engine, but it has yet to find a buyer.

Since the publication of the 1960 report, the corporation has made further advances which will affect its future business. It has long been obvious that Pratt & Whitney are anxious to stretch the JT3D turbofan to thrusts in excess of 20,000lb, and the selection of the JT3D-8A (page 424) for the C-141 opens the door to such development. The other major factor is the possible choice of the Sikorsky S-61D by West Germany.

Straight and Level

"UNDER *a safety regulation every civilian helicopter pilot crossing London must follow the line of the river. I am told only one civilian pilot persistently breaks the rule—the Duke of Edinburgh. When he flies in and out of the Palace garden he takes whichever route he fancies.*"—John Gordon, *Sunday Express*, March 19.

The facts are that Queen's Flight helicopters have to adhere strictly to a flight path along the Mall and across 500yd of Whitehall to Hungerford Bridge. Thence they have to fly east or west along the river till they are clear of London. This flight path is imposed on Queen's Flight by the Air Ministry and by the Ministry of Aviation, and I believe it has always been strictly adhered to. The Duke does not "persistently break the rule," nor does he ever "take whichever route he fancies."

* * *

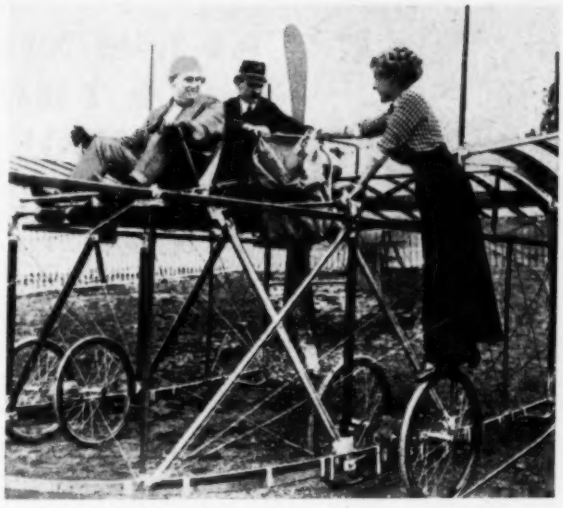
In the following week's *Sunday Express*, John Gordon wrote: "Woe, woe, woe. I am in trouble with the Duke of Edinburgh. He is very annoyed with me because I said he is the only civilian helicopter pilot who flies over the housetops of London . . . A letter of complaint from Buckingham Palace says I am misinformed. I accept the Duke's word, of course, and regret having upset him."

But this was not the most gracious of apologies. Mr. Gordon went on to say that the letter from the Palace contained admissions which "confirm the other points I made—that he does fly over the housetops of London." Whether or not the letter from the Palace contained such admissions we will never know; we must accept Mr Gordon's word for that. But what we do know—simply by re-reading the original *Sunday Express* article—is that John Gordon *never made the point that the Duke flies "over the housetops of London.*"

Even if he had made that point it would have been misleading, because the few hundred yards of the Whitehall area concerned are hardly residential, and if the Duke got into trouble over the Mall he would probably land in St. James's Park.

To err is human, to coin a phrase. But for a journalist to misquote himself in order to vindicate an error is hardly likely, I would have thought, to enhance the reputation of the Press.

"Such a nice pilot, and that postman too —they always wait for me when I get a little behind with my correspondence . . ."
Trepid aviator (thinks): I wonder how much it weighs?
Postman (thinks): I hope it's registered



● A revolutionary recommendation for a "multi-storey car park" is put forward in the report—just published—of the special Ministry of Planes committee set up in 1948 to study the car parking problem at London Heathrow.

Questioned at a press conference in London last week, Dr J. Nit, chairman of the committee and famous British air expert, explained the purpose of the multi-storey park. "Ground space at London Airport is at a premium," he declared. "Car parking is rapidly becoming a serious problem. Our researches show this clearly. It therefore seemed to us sensible to make the most economical use of the limited space by building a series of car parks, one on top of the other. We call it a 'multi-storey car park,' and it is the invention of British engineers. We are hopeful that the Planes Minister will accept the idea, which I have no hesitation in saying is a technololological break-through in airport car park design."

Asked to comment, a Ministry of Planes spokesman said last week: "The idea is certainly interesting and we are keeping it under active review. The possibility of setting up a special joint working party to study the problem could well be considered by an inter-departmental committee shortly to be set up."

There's a Masai warrior's tribal head-dress in the cockpit of my Hunter, sir.
A Masai warrior's head-dress in your cockpit, Biddicombe? How do you know it is a Masai warrior's tribal head-dress?
Because there's a Masai warrior in there wearing it, sir

Correction

In a recent issue of Straight and Level it was stated that the *Daily Clanger* "printed a correction to an article about the SBAC in very small type in the bottom left-hand corner of one of the middle pages of its early edition." We are asked to make it clear that the *Daily Clanger's* correction appeared in very small type in the bottom right-hand corner of one of the middle pages of its early edition.

● I've just been reading a remarkable article in *Time* about anxiety. I learn that the University of Illinois have found the highest anxiety ratings among writers and editorial workers. They come just ahead of naval underwater demolition teams.

I'm not anxious. I'm NOT! I'm NOT! I'm NOT!

Surprise! Surprise!

● "One of Britain's latest turboprop airliners, the Handley Page Herald, is expected to make a surprise visit to Sandown airport in the Isle of Wight on April 4."—*From an Air Safaris press release, March 27.*

ROGER BACON

Artist's impression of the "Twin Otter" being prepared for flight, and in flight. This, the first design-study of the Caribou, was scrapped as its payload was commercially unattractive

BACKGROUND TO THE CARIBOU

Design and Development of de Havilland Canada's Versatile Twin

BY DENIS NEWMAN
(Research Information Service, Engineering, DHC)

THE outstanding success of the Beaver and Otter, and the satisfaction they have given to both civilian and military customers throughout the world, triggered the de Havilland Canada design team to plan a twin-engined aircraft with all the attributes of these two workhorses. Like its predecessors, the new aircraft would have to be rugged and would be required to operate in undeveloped areas where restricted, rough landing strips and the most elementary maintenance facilities are the order of the day.

The witches' chant in *Macbeth* might well describe the emergence of the Caribou aircraft as it appears today. A bit of this and a touch of that—ideas, experience and tests—have all added so much to the original concept that there is little similarity between the first design-study and the present production aircraft.

The original study, completed in October 1954, produced something in the nature of a "Twin Otter." It was equipped with P & W R-1340 engines, had fixed landing gear, and was designed for a gross weight of 13,000lb. The practical payload for this aircraft worked out at only 3,000lb for 300 miles, not appreciably greater than that of the Otter. Slide-rules also indicated that the performance was limited by a ceiling which dropped off very rapidly at weights above 13,400lb, and field size for take-off also became very large. As there was little or no potential for development the study was scrapped while still on paper.

The design team now realized that an aircraft which failed to meet CAR 4b transport-category standards with a reasonable payload would be unlikely to find a market to justify production. In the second study a project having a gross weight of 22,000lb and 1,200 h.p. engines was examined. This again was dropped when it became apparent that the thrust:weight ratio was too low, that a span only slightly less than infinity was needed to meet one-engine performance requirements, and that the maximum payload would not make the aircraft commercially attractive.

Early in 1956 a preliminary performance analysis was carried out in order to decide on the most suitable powerplant and gross weight for the Caribou. Five powerplants were studied for the twin version—three piston engines and two turboprops: the P & W R-1830-92; P & W R-2000-D5; Wright R-1820-82; Rolls-Royce Dart 511 and an early version of the Lycoming T55. An analysis of a four-engined version using P & W R-1340 was also undertaken.

The conclusions of this study showed that the unpressurized Caribou, powered by two P & W R-2000-D5 engines, gave a maximum weight limit of 28,500lb and was, from a work-capacity angle, superior to other versions considered. It was also concluded that the aircraft could not be economically operated with a turboprop powerplant unless it was designed to cruise at or over 250kt above 20,000ft—the reason was, of course, the comparatively high specific fuel-consumption of turboprops, especially at moderate cruising powers at low altitudes, and the power losses associated with high ambient temperatures.

Although the Caribou is conventional in appearance, it was necessary to analyse a number of low-speed aerodynamic problems in more detail than is usual, and to have these results substantiated by model tests where possible.

Wind-tunnel models were used to establish aerofoil properties, flap and tail surface geometry and other characteristics. In tests where there were large components of downwash it was recognized that tunnel results should be treated with reserve, and considerable work was performed with models mounted on a truck. The instrumentation of these models was as simple as possible, usually consisting of a few pressure taps, a strain-gauge on the strut supporting the tail, or wool tufts and a camera. These techniques proved so useful that it was decided to mount models with internal load-measuring balances on an Otter aircraft for flight test. The supporting structure was designed to provide a variety of pick-up points and to transfer load components directly to recording equipment without annoying coupling effects.

The general arrangement of the Caribou was dictated by performance requirements. A moderately low span and wing loading

An early model of the Caribou fitted with a twin fin and rudder being tested on a truck for the study of flow characteristics. Right, a year later a more recognizable model takes to the air, mounted on an Otter

Extensive flight testing was necessary to provide a satisfactory answer to the complex flow-patterns in the wing wake associated with large flaps and powerful slipstream effects. Almost every part of this Caribou's surface is wool-tufted

are essential to provide STOL characteristics, a good climb after take-off, and a reasonable single-engine ceiling on a hot day with an economical powerplant.

In planning the fuselage, considerable thought was given to facilitating cargo loading and unloading. Various designs and models were investigated, using a fuselage with a swept-up rear, twin booms and pod and sting. Aeroelasticity and drag analysis showed the former to be the most efficient. From a practical point of view too, the rear loading doors, adjustable ramp and cabin floor at truck-bed height provided a number of obvious advantages. The cabin of the "Twin Otter" version would seat 18 and had a volume of only 600 cu ft; this has increased steadily with each subsequent study, until the prototype appeared with a volume of 1,000 cu ft and a seating capacity of 28. Flight tests, however, showed that the stability at the expected aft c.g. was not adequate. In order to obtain the guaranteed range of c.g. travel the forward c.g. was extended by moving the entire loading range forward. This was achieved by splicing in a 45in section of fuselage in front of the wing, thereby increasing the cabin volume to 1,150 cu ft and the seating capacity to 32.

With the floor of the cabin at truck-bed height it was found necessary to have a high-wing layout to ensure adequate clearance for the propellers and wide-chord flaps. The original design study of the "Twin Otter" allowed for a wing span of 72ft, moderate wing taper, conservative aerofoil section and ailerons of ample span which drooped with the outboard flaps. Apart from an increase in size for increasing gross weights, following wing-design studies conformed in general with the original.

The wing on the production Caribou has a large span of 96ft to ensure a good hot-day ceiling with one engine out. To provide good stalling characteristics the wing has a 64-series section inboard, fairing into 63-series with increased camber and some washout at the tip. Large double-slotted flaps cover the entire span with the trailing portion, outboard, serving as ailerons. The mid trailing flaps are linked to the controls so that they also move as ailerons when the flaps are extended. This arrangement provides a high rate of roll at low speeds without excessive control forces at cruising speeds. Single-slotted flaps sliding aft to increase wing chord were considered as an alternative, but track and rollers were thought undesirable for this type of aircraft.

The centre section is continuous through the fuselage and has a marked anhedral angle. The purpose of this is to give the pilots a better field of view to the rear, to lower the thrust line and to reduce the length of the main landing-gear legs.

During design of the empennage a number of problems came to light. In order to provide good single-engine handling qualities at low speeds it was agreed that minimum control speed should be equal to the speed used in the maximum performance take-off, or in the landing approach before round-out, whichever was the lower. Engine failure under these conditions produces a large yawing movement from the full thrust of the line engine, together with destabilizing aerodynamic forces caused by ailerons and the dynamic effect of over-swing. To counteract these forces a vertical tail working at a moderate angle of yaw, is required; and where low speed are concerned a really large tail surface is necessary. The designers considered the single vertical tail; but, as a high aspect-ratio is an advantage, they were more attracted to the twin fin and rudder with a horizontal tail having a large dihedral angle to give additional directional aid. However, after extensive studies it was found that there were structural and aerodynamic disadvantages with this type of empennage, and so the single vertical tail was reintroduced.

The horizontal tail is mounted fairly high on the fin to avoid slipstream boundaries. Even so, a considerable amount of analytical and experimental work failed to provide a satisfactory answer to the very complex flow patterns in the wing wake associated with large flaps and powerful slipstream effects. It was decided, therefore, to launch the prototype with aspects of the design of the horizontal tail incomplete, and make design changes from flight-test data. Tuft studies in flight tests showed that, with flaps down, the upswept fuselage was moving sideways through the downwash field and it was necessary to watch the cross-sectional shape of the fuselage carefully in order to avoid a vortex-pattern wake which was both unstable and conducive to a "snaking" type of directional oscillation. Fortunately, when the cargo doors were accidentally opened in flight this characteristic disappeared, and the source of the trouble was found and rectified.

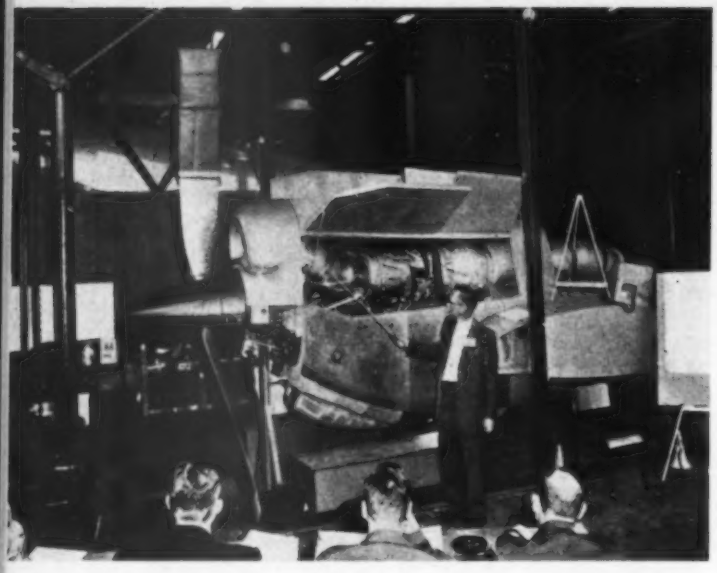
Selection of landing gear for the Caribou gave the design team much food for thought. Ideally, a multiplicity of lightly loaded wheels or a track type of gear are required for rough field operations, where the intensity of individual wheel loads applied to the ground are of prime importance. Construction of this type of gear is complicated and maintenance is difficult; these factors, and other shortcomings in the way of weight and size, precluded its use on the Caribou. Instead it was decided to employ a simple tricycle layout with low-pressure tyres.

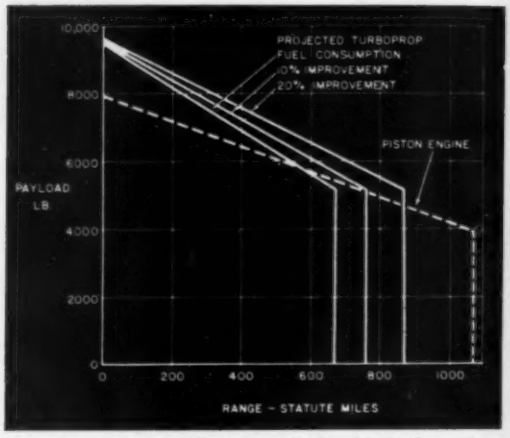
The "Twin Otter" was designed with a fixed landing gear. As the size of the aircraft increased in subsequent studies, relatively large dual wheels were introduced and a retractable gear was fitted to reduce drag. The low-pressure dual tyres and wheels gave the Caribou a UCI (Unit Construction Index) of 10.5, well below the maximum of 15 recommended by the USAF for STOL aircraft.

Low-pressure dual tyres and wheels gave results beyond expectations: a Caribou landed on, and took off from, this quagmire

The Caribou as it appears today in service with the United Nations

BACKGROUND TO THE CARIBOU . . .





Piston engine versus turboprop study for the Caribou. Gross weight, 23,000lb; piston engine, 1,450 b.h.p.; projected turboprop, 1,920 e.s.h.p.; cruise, 180 m.p.h. (on 725 h.p.) at 7,500ft

General Electric's 2,700 h.p. T64 engine, described in our January 13 issue, will fly for the first time next month, in its turboprop form installed in a de Havilland Caribou. The present schedule calls for 20hr ground running and 100hr flying on each of two engines, followed by 300hr of full flight-testing. This photograph shows the installation mock-up at a planning session in the de Havilland Canada plant

For special missions it is possible to fit much larger wheels with very-low-pressure tyres which will reduce the UCI to about 9. Unfortunately these wheels and tyres are too large to retract into the nacelle, and fixed gear is necessary when they are used.

A short landing over obstacles is possible only with a steep approach and no float, and this manœuvre requires landing gear with a high energy-capacity. The disadvantage of the long-stroke leg required for energy capacity is that it provides a "spongy" platform for loading and when taxying. Jarry Hydraulics Company, the designers of the Caribou's landing-gear components, devised an ingenious two-stage shock strut which is quite stiff over a small range of displacement about the ground static position. Another interesting feature of the main leg is a mechanism which shortens the gear by some 18in to allow it to retract in the nacelle. The shock strut is not compressed in this process but slides as a complete unit inside the main structure of the gear. Far from complicating the mechanism this arrangement facilitates servicing, as the shock strut can be removed without having to take the whole gear from the aircraft.

Although the Caribou's performance was well up to the expectations of the design team, planning is going ahead to improve it still further. For Arctic conditions provision has been made in the basic design to fit wing, propeller and empennage de-icing equipment, and for the ground operation of cabin heaters. Studies are also being undertaken to fit the aircraft with skis. Successful trials have been carried out with reversing propellers to reduce still further the short landing run of the Caribou.

Use of turboprop powerplants has never been far from the thoughts of the design team, and a number of studies have been carried out to find suitable, economic engines of this type. A study carried out in 1958 (see graph) shows the comparative payload range improvement due to reduced fuel consumption in turboprops. Such gains are now possible with current small turboprop engines, and a combined Canadian and US Government project is now under way to evaluate the General Electric T64 turboprop in flight tests in the Caribou. We look forward to the results.

FORTHCOMING EVENTS

Apr	10	RAeS Historical Group: Discussion Evening.
Apr	10-11	Loughborough College of Technology: Symposium on "Applications of Analogue Computers."
Apr	11	RAeS: "Direct Electrical Power Generation by Thermal and Chemical Means," by Prof M. W. Thring.
Apr	11	Guild of Air Pilots and Air Navigators: Annual Banquet.
Apr	12	RAeS Graduates' and Students' Section: "Man-powered Flight—Progress to Date," by H. B. Irving.
Apr	12	Kronfeld Club: "Pilcher, the Pioneer of British Aviation," by Lord Brabazon.
Apr	12	Society of Environmental Engineers: Discussion on "Climatic and High-vacuum Environmental Test Chambers."
Apr	19	RAeS Agricultural Aviation Group: "A Review of Current Developments in Agricultural Aviation," by Dr W. E. Ripper.
Apr	20	RAeS Astronautics and Guided Flight Section: Symposium on Air Traffic Control.
Apr	25	RAeS: "On the Origin, Structure and Growth of Vortex Separations," by E. C. Maskell.

RAeS Branch Fixtures (to Apr 13): Apr 10, *Boscombe Down*, Film Show; *Derby* (joint lecture with Derby Centre of the Automobile Division of Institute of Mechanical Engineers), "Progress in the Lubrication of Gas Turbine Engines," by J. S. Elliott. Apr 11, *Gloucester and Cheltenham*, a.g.m. and Film Show; *Luton*, "Reliability," by Air Marshal Sir Herbert Spreckley. Apr 12, *Hatfield*, Discussion Evening; *Preston*, "Experimental Stress Analysis," by Dr B. Parsons. Apr 13, *Belfast*, a.g.m.

Genuine Antiques

Unearthing the Unknown: Results of a Search for TV Material

by G. Wansbrough-White, ARAeS

The only known photographs of the Parnall Zepp-Chaser of 1916

THE fiftieth anniversary of powered flight in 1953, the anniversaries of aircraft firms, the establishment of the Historical Group of the RAeS with the Nash and Shuttleworth Collections, and the early beginnings now remembered by only an honoured few—all these have focused increasing attention on aviation history.

This tendency is reflected by the many books that have and are being published. That the main stream of British aviation history has been well covered does not preclude the fact that there is much yet to be done—such as Laurence Pritchard's work into the life of Sir George Cayley; and no doubt Gibbs-Smith has mysteries yet to solve.

An itinerant and inconsequential amateur, it has been my good fortune to uncover some odd historical items—not particularly important, but interesting and then unknown. An early effort was piecing together the story of the naming of British aircraft and engines, which took some ten years before all documentary evidence was found. Some unknown RAF names came to light, and were duly identified with aircraft; the one exception was the Denbigh, which is not conclusively identified to this day (but is believed to be the DH.26).

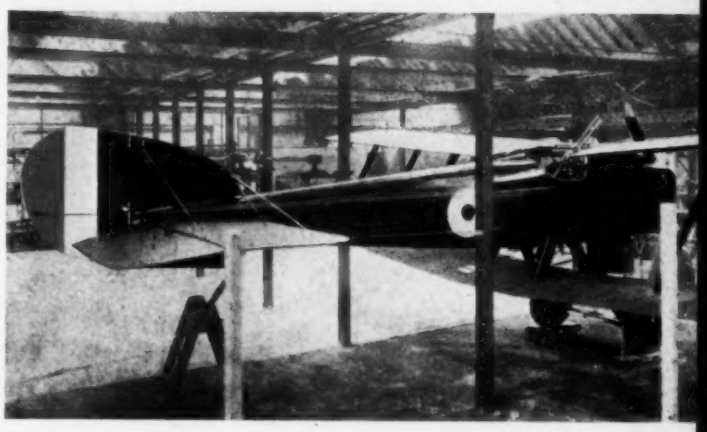
Early in 1960 I undertook to produce a television programme for TWW. Called *Wings in the West*, it was a pictorial history of West Country aviation based on an aerial pilgrimage by Peter Masefield in his Chipmunk and myself (with two cadets) in an Auster. As we flew over each centre, such as Bristol, Gloucester, Yeovil, Cardiff and Cheltenham, its history was told by old prints, posters, photographs, and film—much of the material from exhausting exercises in various archives.

During the research for this programme I was delighted to find some aircraft which (with one exception) I believe to have escaped our known history. If this is so, they are now presented or illustrated for the first time.

Parnall Zepp-Chaser The first is the Parnall Zepp-Chaser (or Strafer), previously only the subject of vague references—not surprisingly, perhaps, for all trace of it had been "officially" obliterated. More information came to light after the finding of the two photographs (which I acknowledge to Parnall's of Yate). For some of the information I am indebted to "Senrab" and to Bruce's *British Aircraft 1914-1918*.

The Zepp-Chaser was built in Bristol in 1916, and the curious may like to compare it with the later Vickers Vixen. Only one prototype was built, Serial No 505, to Admiralty Contract CP.124455/16/24486, and was designed by A. Camden Pratt. Technical data are:—

Span, 44ft (upper wing), 40ft (lower), tailplane 18ft. Chord, 7ft (upper wing), 5ft 6in (lower). Stagger, 4ft. Dihedral, 4°. Incidence, 2°.



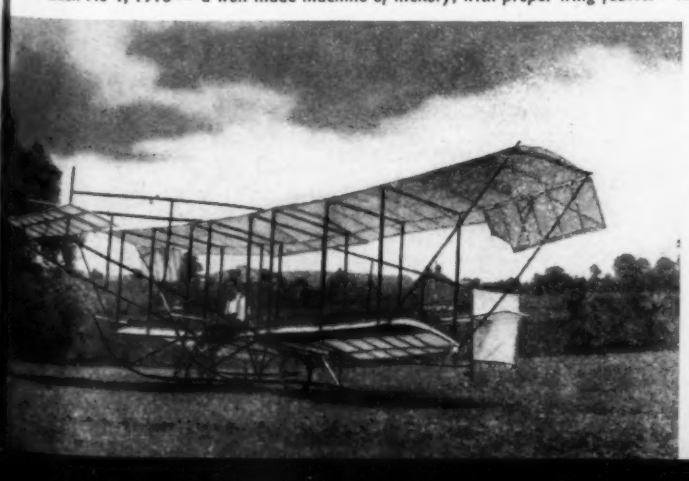
Areas (sq ft): wings, 516; ailerons, 36; tailplane, 74; elevators, 38; fin, 6.5; rudder, 12.75. Engine, 240 h.p. Sunbeam-Coatalen Maori II. Fuel tankage, 36gal. Speed (estimated), 113.5 m.p.h. at sea level, 101.5 m.p.h. at 10,000ft. Armament, one 0.303in Lewis gun. Finish, black with normal roundels.

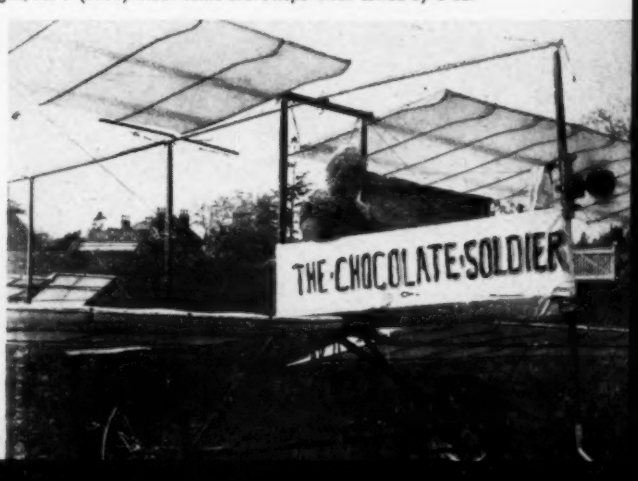
The gun was mounted at 45° elevation on the starboard side of the cockpit so as to achieve a straight trajectory at 100 m.p.h. in a shallow dive. This method of attacking airships at night had been worked out at Orfordness and applied to many home-defence aircraft with some success.

Considerably over-weight when completed, the Zepp-Strafer was condemned when check stress-calculations by the AID at Upavon showed that reserve factors were dangerously low. So it never flew, but was broken up at Yate and burned with, so it is believed, drawings and data. The photographs lay unrecognized, if even looked at (wait for the correspondence!) until 1960.

There is an odd twist to this odd story. I was writing the draft of this article in the Library of the Royal Aero Club, and passed the photographs to Keith Davies (RAeC Certificate No 22, and the first man to fly in India) with a remark to the effect that he'd never seen a machine like this when he was in the RFC. After a long pause to study the photographs, he quietly told me much

Bush No 4, 1910—"a well-made machine of hickory, with proper wing-fabric." Right, No 7 (1910) made some short hops when towed by a car





Bush No 9 "Motorplane," built in 1912, was a Caudron-style biplane with a 30 h.p. rotary engine

Genuine Antiques . . .

about the machine, in spite of the admitted fact that he had not even known that the Zepp-Strafer as such had been built! But how? Mr Davies had been chief test pilot for Parnall at the time, and had laid down a design study for such an aircraft to fight Zeppelins. Now he recognized it after 44 years; he had left Parnall's without knowing it was to be built. Apart from the historical aspect, the coming together of two people in one place at one time to discuss by chance one utterly obscure subject must be a coincidence to make the statistician run out of noughts. . . .

If the aircraft is now known to some, I believe the photographs never to have been published before.

The Bush Aeroplanes The second find was a remarkable story discovered from a casual look at the family album of Dr Gilbert Bush, a radiologist now in retirement. The photographs of the aircraft are taken from this album, and their story is best told in his own words:—

"It was about the year 1909, or a little earlier. Two of my brothers and I—aged 17, 13 and 16—had been following the early experiments by the Wright Brothers and others with great interest. We had constructed various model aeroplanes of different types and flown them successfully, and devoured the weekly magazines such as *Flight* and *The Aeroplane* as they appeared. Grahame White and Cody were our heroes, so we decided to try and emulate their efforts to build a full-sized glider.

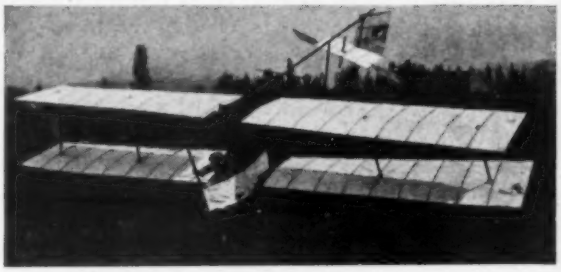
"Funds were as sparse as pocket-money, but somehow we managed to raise enough to buy some carefully chosen ash—the more suitable hickory was too expensive—for the framework, with a selection of special bolts and steel wire. Aeroplane fabric was out, so we used calico doped with a thin paste made from sago. Struts and spars were all carefully streamlined by spokeshave and plane, and then varnished.

"Several machines were built in the course of a year or two, designs being modified by trial and error on our test hill at Keynsham, near Bath. This was unfortunately too short and restricted in area and height for more than short hops into the air. Towing a glider with a car was also tried, but we could not get up enough speed in the only available field at that time. No 1 was modelled on the Wright Glider, but the ash proved too heavy and so was shaved down, and with careful rigging of piano-wire became the "refined" No 2. This was tried with and without a pilot, but found to lack fore-and-aft stability—all in the game of trial and error. So No 3 had a largish single tailplane, and was made as light as possible consistent with strength (?). We had to wait long periods for an easterly breeze, but did get the glider into the air for a few yards.

"No 4 was a glider built by my elder brother while at Cambridge, probably helped by a University Group with funds; this was in 1910, and I have no definite information on its flying; but it was a well-made machine of hickory, with proper wing-fabric. Nos 5, 6 and 7 were all further modifications, cutting out the forward elevator, and using up parts of previous models. No 7 (*The Chocolate Soldier*) was put together in a week when my brothers had a chance of using a car to tow it about the field and try for some short hops. But the car wasn't fast enough, and No 7 (as illustrated) suffered a smashed undercarriage.

"Except with models, I myself did no more after that, but early in 1912 my elder brother designed and built No 8 in a workshop in Bath, a neat little biplane of the Caudron type for which he hoped to get an engine. Later a 30 h.p. rotary was offered on loan and the nacelle modified to take it, to become No. 9. Trials of the engine, and taxying, were done at Keynsham in 1912, but the propeller shaft broke; before he could get another he went to Canada and experiments ceased, much to the relief of our harassed parents. Only one of the Bush Motorplanes (referred to in *Flight* at the time) was produced, and the small company which he had formed fell through when he went abroad.

"But the experience gained was invaluable if later tragic. On his return from Canada in 1915, my elder brother joined the RNAS and was killed when hunting submarines from Fishguard in 1917. My other brother became an RFC pilot in 1916, and miraculously survived a very bad crash in 1917."



"The Chocolate Soldier" comes to grief

I think Dr Bush's story is worth telling, not only as an early technical effort—with some little airborne success—but because of the youth of the three brothers—17, 13 and 16—at the time they began construction.

Bristol History One photograph, not identifiable with the Bush series, proved to be of the "Bristol" glider built by the British and Colonial Aeroplane Co and presented by Sir George White, as president, to the then West of England Flying Club. Now that the long-sought photograph of the "laboratory" machine is to hand (*vide* Senrab and Andrews), the Bristol Aeroplane Company's pictorial record is almost completed by this picture of their only glider in action.

A most satisfying historical activity was to help in the recovery of Capt Frank Barnwell's Viale engine, used in the Bristol Babe in 1919 (and previously by A. V. Roe in 1910 and 1912); it was illustrated in *Flight* for February 12, 1960, and is now with the Nash Collection.

On a more disappointing note, I have to report that the last flying Blenheim of the Finnish Air Force is not available to Britain, and has ended her days in a Finnish museum. A last-minute effort was made to recover one of three Mk Is delivered to a junk yard in Finland. Too late—they are now scrap. But it helps a little to know that Finland has the first British aircraft to see action in 1939—indeed a genuine antique.

Bristol "Challenge" glider presented by Sir George White to the West of England Flying Club, 1910

A McDonnell F-101 Voodoo of the 78th Tactical Fighter Sqn, flown by Capt Dudley J. Foster, gets airborne from RAF Woodbridge

VOODOOISM IN SUFFOLK

USAF 81st Tactical Fighter Wing

Training—in the UK and Africa

Text by Humphrey Wynn

"Flight" photographs by Ian Macdonald

AROUND teatime on the narrow Suffolk roads leading to Woodbridge and thence to Ipswich you may observe the fairly exotic sight (for the countryside) of a traffic-jam. British, American and German cars lie nose-to-tail, most of them with one occupant: a member of the United States Air Force wearing some variation of basic pale-green working uniform, with either windcheater jacket or fur collar or peaked baseball-style cap, sometimes smoking a cigar.

These car queues form when the working-day ends at the two USAF bases at RAF Bentwaters and Woodbridge. With nearly 3,000 personnel, only a proportion of whom live in quarters, there are quite a lot of people wanting to get home. Above the slowly moving cars (the route towards the A12 and Ipswich is complicated by a level-crossing) you may see the black exhaust trails of the Pratt & Whitney J57s in a McDonnell F-101 Voodoo coming in to land at one of the two airfields. These are only three miles apart and both are used by the 81st Tactical Fighter Wing, only unit in the United States Air Force to be equipped with the tactical fighter version of the McDonnell F-101 Voodoo.

The wing's headquarters are at Bentwaters and it controls three squadrons, the 78th (Bushmasters) at Woodbridge and the 91st (Blue Streak) and 92nd (Avenger) at the h.q. station. All the aircraft used by the squadrons are F-101A or F-101C fighter-bombers; the only outward difference is in the colouring of their tails: the 91st and 92nd wear blue and yellow respectively, the 78th red. In official terms the mission of the wing is "to conduct special operations against aggressor forces in Europe in support of NATO, as directed by Headquarters, Third Air Force."

Bentwaters airfield had a late wartime existence as a fighter station (it was opened on December 13, 1944) and was handed over to the USAF in 1951. This date coincided with the arrival in the United Kingdom of the 81st Wing, then an F-84 unit; the F-101s with which it is now equipped have been in USAF squadron service since May 1957. Woodbridge, which has a 9,000ft runway (with two over-runs, each of 900ft), was opened in November 1943 and used as a wartime emergency landing ground for British and American aircraft. By the end of June 1945 there had been 4,120 emergency landings there. Construction of the airfield involved the felling of over a million and a half trees.

Both the F-101A and F-101C have Pratt & Whitney J57-P-13 engines with afterburner, giving a total thrust of some 30,000lb. The only difference between the two marks is that the C has been strengthened for low-level fighter-bomber operations; it carries a pylon and crutch for nuclear weapons under the fuselage, between two 450 US gal external tanks. Both types have three 20mm cannon, one of the original four guns having been removed to house TACAN equipment.

The Voodoo is a "one of a kind" fighter, equipped to find its way to a target at low or high level, to destroy that target with a nuclear weapon and if necessary to defend itself against other aircraft. Training at Bentwaters and Woodbridge is therefore planned with two main purposes: locating a target, and destroying it by an over-the-shoulder bombing technique. Squadron pilots (many of whom have previously been on F-100s) do long cross-countries at low altitudes, each sortie lasting about 2hr, or longer if the Voodoo is flight-refuelled. They practise bombing on the Jurby (Isle of Man) range and also out in Libya, from Wheelus Air Base, the USAFE Weapons Centre. The training period is divided into four phases, and each pilot may have done as much as 100hr practice flying before being considered in a state of "combat readiness."

The 81st Wing is commanded by Col Eugene L. Strickland, a soft-spoken Texan who during the war served with the Chinese-American Composite Wing. His deputy is Col William C. Clark and the three squadron commanders are Lt-Col John Burns (92nd), Maj Jack Lincoln (91st) and Lt-Col Pete Stuyvesant (78th).

A visitor to Bentwaters, if he arrives by road and not by air, may be excused if at first he fails to find the main entrance to the station. There is no gateway and guardroom in formal RAF style, rather a state of inconspicuous uniformity about the buildings. (There is a great deal more domestic accommodation at Woodbridge.) Bentwaters looks like a place geared to military effort; its wartime construction is still plainly evident. In Col Strickland's office, and other headquarters buildings, there is some compensation for the drab exterior: flowers planted in a bed raised on a low wall enhance the entrance vestibule. In the Officers' Club the restaurant is bright with women's voices (there are 4,900 dependents of the 3,000 USAF personnel at these two stations and at Anglia Control, Wattisham) and the determined chink of fruit machines. In the pilots' rooms, with some doors marked "secret," there is a purposeful atmosphere of pre-flight planning; softer requirements are catered for by coffee and armchairs.

Each squadron has its separate headquarters at Bentwaters, and the whole wing is given direct support by the field and periodic maintenance squadrons, the armament and electronics squadron,

Over the vertical in a simulated LABS manœuvre

F-101 profile in close-up. Above the USAF markings can be seen the dragon badge of the 81st Tacti

bombing technique (low altitude bombing system) has been in use by the United States Air Force for some seven years; it is now being superseded, but no details of replacement equipment have yet been given.

With tailwinds, the Voodoos can reach Wheelus from Bentwaters or Woodbridge (approximately 1,400 miles) in just over 2hr, though this is not really surprising for an aircraft which as late as December 1957 held the world's speed record: Maj Adrian Drew, now a member of the 81st, achieved an average of 1,207.6 m.p.h. in two measured passes. Navigation to North Africa is entirely by radar, again not unexpected in an aircraft with an all-weather capability. The Voodoo pilots are as at home on the long-distance missions as they are on the (comparatively) short tactical ones. Ability to refuel

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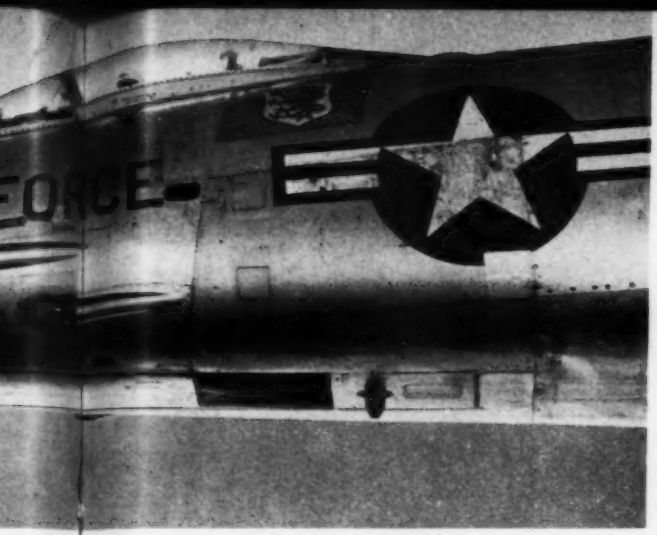
Four Voodoos of the 81st Wing, led by Maj C. R. Osborne, over the ruins of the Roma theatre a

VOODOOISM IN SUFFOLK...

headquarters squadron (which includes the directors of operations and maintenance) and 81st Support Group—whose functions cover everything from bricks to bread—which is commanded by Col Jack R. Best. In addition there are certain attached units, the 7519th Communications Sqn which has charge of ground radio and telephone communications and the 1264th AACS (Airways and Air Communications Service) Sqn whose responsibilities cover airfield and air-to-ground equipment.

Bentwaters has an 8,700ft runway and its concrete areas and associated buildings take up some 850 acres of countryside. On the north side are test-beds where engines can be run up (much to the aural discomfiture of local farmers) and to the north-east is the 92nd Sqn location, its Voodoos distinguished by their yellow tails. The unit maintains 26 aircraft, pilots and machines carrying out a constant rotation—like those of the 91st and 78th—between their home base and Wheelus.

Although Bentwaters and Woodbridge have as good a weather factor as anywhere in the United Kingdom, with flat approaches on all sides, the availability of a training area outside Europe is a great asset to the Voodoo squadrons. With F-100 and F-102 units from bases in Europe, they practise combat techniques in North Africa with a regularity ensured by comparative freedom from cloud and rain. The range used by aircraft flying from Wheelus is in the north-west corner of Tripolitania, at El Uotia, about 75 miles from Tripoli. Runs are made either from north to south or from south to north, the F-101s going in at about 100ft and around 540kt for their LABS manœuvre. The aircraft reach the top of their half-loop at about 15,000ft, having released a practice bomb when at an attitude of about 70° to the vertical. The bomb then has an upward trajectory (to approximately 22,000ft) before descending. This



badge of the 81st Tactical Fighter Wing

in flight gives the F-101 an almost unlimited range. In August 1958, for example, seven of the Wing's aircraft flew nonstop from Bergstrom AFB in Texas to Bentwaters—a distance of 6,100 miles. The only limit on the versatility of such machines, as with the English Electric Lightning which is similarly a one-man weapon system and which many of the Voodoo pilots have expressed their eagerness to fly, seems to be the endurance of the pilot.

All pilots on the 81st Wing carry out around two operational exercises (or "alerts") per month. They have also to maintain an instrument rating and this is made possible (in the absence of two-seat F-101s, which only exist in the reconnaissance version) by the $2½m Westinghouse simulator at Bentwaters. Like Hunter or Javelin pilots in the RAF, the Voodoo pilots practise all emergency procedures on the ground; they are so familiar with their machines as to be able to cope instantly not only with information received through their instruments or by UHF but also with any emergencies.

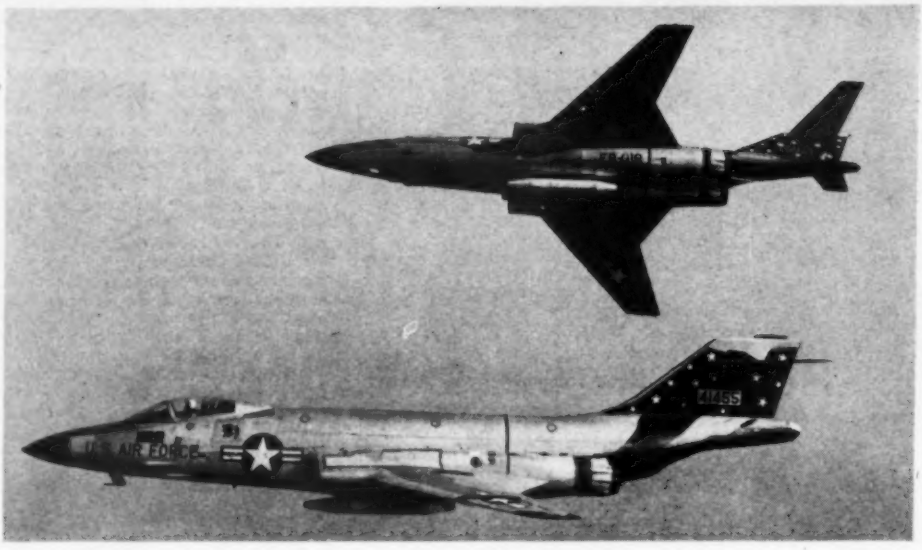
With such a complex aircraft as the Voodoo, unserviceability is not unexpected, but availability of aircraft is kept up by round-the-clock maintenance. One problem which has occurred is that of condensation moisture affecting radar equipment in the nose. This has been temporarily countered by the use of covers inside the cowlings, though no official modification has yet been devised. Another problem is that of tyre usage, with a 20-ton aircraft imposing considerable acceleration and deceleration strains on narrow wheels with high-pressure tyres. Each tyre is given two points for a normal landing without overload tanks; the pointage is higher, and consequently the life shorter, with take-offs and landings at heavier weights. Another hazard which may occur at low altitudes is that of birds flying into the engine intakes. This happened at Wheelus recently. The only evidence found was a single feather; but the engine had to be removed for inspection of damage to the turbine blades.

Voodoo pilots are probably older than those doing a first tour on fighter squadrons; their average age is given as 31. If married, they do a three-year tour overseas; the tour for an unmarried man is two years, but these periods can be extended and the UK is a popular posting.

The training routine for a new pilot with the 81st Wing indicates the thoroughness with which Voodoo operating techniques are indoctrinated. His first week is spent at ground school, run by the Mobile Training Detachment, learning all about the aircraft's systems. Then he does 10hr flying on the flight simulator at Bentwaters, getting practice in the procedures and emergencies. This is followed by three days of what is called "theatre indoctrination," that is acclimatization with local weather and traffic rules, an essential piece of training for pilots coming straight from the United States. The new pilot then has two flights in a T-33 for checks on his instrument flying and landing procedures: these are given by staff pilots of the base instructors' school. Next, he has to take a written examination, answering a questionnaire which throws at him a hundred queries about the aircraft and its operation. He studies the bulky pilot's handbook on the Voodoo (equivalent to the RAF pilot's notes, in loose-leaf form for the addition of amend-

f the Roman theatre at Sabratha, west of Tripoli

VOODOOISM IN SUFFOLK . . .



Peel-off by Capt Duane E. Boye, flying 60018 in company with Capt Foster. Below each fuselage can be seen a bomb dispenser, which carries half-a-dozen 25lb practice bombs

ments). He is assigned to one of the four flights in a squadron, each having approximately seven pilots with a captain as flight commander, the latter briefing the newcomer on all he should know about the organization of which he has become a member. Then it is time for the new pilot to start flying the Voodoo.

He is obviously no stranger to the cockpit when he climbs into the aircraft for his first flight; all the procedures and drills have been well rehearsed. But this time he is all on his own as there are no dual F-101s on the Wing; but nothing has been left to chance and he is as fully indoctrinated as possible. His initial flight is made under VFR conditions and afterburner is not used for the first two take-offs.

During what is called the check-out programme or "transition" (i.e., conversion) period, ten flights are made: they cover such conditions as asymmetric performance; maximum rate of turn; maximum g; instrument climb and descent; formation; night flying; cruise control; navigational cross-country to check cruise control. The Voodoo has radio compass, TACAN and UHF; but pilots are required to be able to navigate without radio, by dead reckoning and map-reading. At the end of his transition, the new pilot is given a check flight (by an accompanying Voodoo, a technique used throughout the Wing) lasting approximately 2¼hr. He has by then done about 20hr flying in the aircraft. He is now ready for up-grading and starts his "combat-ready" training.

This involves GCA approaches; navigation (maximum range cross-country without radio aids and low-level cross-country at between 300 and 1,000ft, usually done over Northern France, regulations being "very strict on where you fly"); bombing, done either on the Jurby range or at Wheelus or at Suippes in France (near Reims); flight-refuelling, contact being made on UHF/DF, the tanker having its own radar from which it gives a course to steer. The Voodoo's endurance with no overload tanks is a little short of 3hr, or 2hr 30min with a landing reserve, on 2,250 (US) gal. With overload tanks of 450 gal each it is at most 3hr 45min, though more usually 2hr 30min or 2hr 45min. Including his trip to Wheelus for bombing, and eight or ten sorties there, the new pilot does 40 or 50hr flying before he can begin to be considered to be in a state of combat readiness, and this normally takes three months. All tactical training comes under the supervision of Col William D. Dunham, a veteran World War II fighter pilot. It is monitored by the evaluation section, headed by Maj C. R. Osborne, one of the most experienced F-101 pilots (over 800hr on the type) on the 81st.

Four of the 81st Wing's Voodoos reflect the Mediterranean sunshine as they cross Tripoli harbour

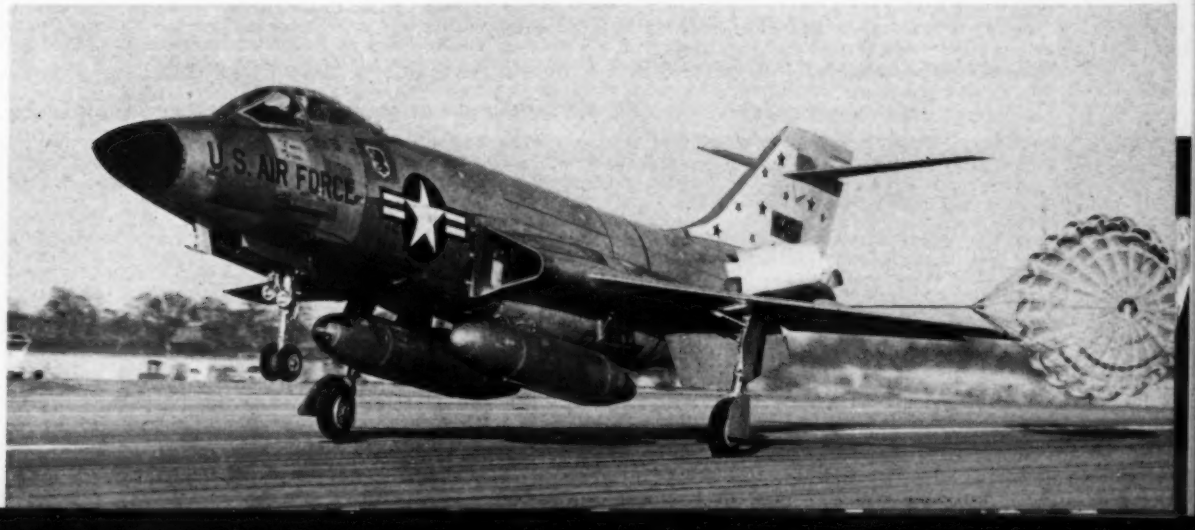
Above: Air-refuelling plays a major part in F-101 operations. Here 018 is about to hook up to a KB-50. Below: Low-level over the desert: one of the 81st Wing's aircraft on detachment to Wheelus Air Base, Libya, for bombing practice

Members of the 81st Wing squadrons do on the average about 25hr flying per month, though this may range from under ten to over 30hr flying. Similarly, their total flying times on the F-101 may vary from more than 800 to less than 50 among the newcomers. Although the Voodoos have an all-weather capability and the pilots are trained to operate at all times under all weathers, normal peacetime safety minima are observed, according to the pilots' green card rating. Similarly, account is taken at Bentwaters and Woodbridge of local conditions: afterburners are cut as soon as possible after take-off; when the Aldeburgh Festival is held, the approach pattern is changed so that the Voodoos avoid flying over the town, which is only some ten miles to the east.

The 81st Tactical Fighter Wing was originally formed in California in 1942, with P-39 Airacobras, their first operational assignment being the North African landings. For this purpose, their aircraft flew direct from RAF Atcham, near Shrewsbury, to North Africa in December 1942. Later the Wing supported the Allied landings in Sicily and Italy, at this period being re-equipped with P-38 Lightnings. When in 1944 it moved to India the Wing converted to P-47 Thunderbolts and went further east to China.

In 1946 it was re-activated, converting from P-47s to F-80 Shooting Stars and then to F-86 Sabrejets before moving to England. Equipment with the F-84 Thunderjet came before conversion to F-101 Voodoos. The Wing is proud of the fact that it is the only unit in the USAF equipped with these all-weather tactical fighters. As its official history states, writing of World War II service and the period since 1951: "Since then the type of aircraft flown, the name and the mission have changed; but the high degree of operational readiness which has always been associated with the 81st since its first combat assignment in North Africa during World War II remains the same."

Sortie completed, touching-down at Bentwaters with braking parachute deployed



SPORT AND BUSINESS

Private View BY P.P.O.

SOME people like flying, some like sailing. Airmanship and seamanship seem to call for very much the same qualities of mind and character.

If you fly for fun, you have the choice of gliding or power flying. It is difficult to keep a business appointment in a glider, but it is the greatest fun. Power flying, pleasurable to a lesser degree unless you fly something light and sporting like a Turbulent or a Nipper, does at least sometimes allow you to believe it when you tell yourself you are doing it for the time it saves.

People who sail, with or without the assistance of a motor, or motor at sea, with or without the assistance of sails, make no claim that their hobby is for any purpose other than pleasure and health. Francis Chichester, significantly a member of the Royal Aero Club as well as of the Royal Ocean Racing Club, made no claim that his single-handed crossing of the Atlantic was for any other purpose but for health, to gratify a desire, and to appeal to his rather exceptional sense of humour.

So it is of no little interest that an attempt is being made to form a Seaplane Club, led by such stalwarts as Lankester Parker, Christopher Paul and Francis Chichester. It could well be the answer for those who love the air and the sea. Flying a seaplane, I am told, is rather more difficult, especially when it comes to landing and taking off, than a land plane. And "boots" do reduce the performance of the ordinary light aircraft. But its attractions make one's mouth water. In the good old days Shorts and Saunders-Roe found no difficulty in designing and making an aeroplane with both wheels and floats.

One of the problems of yachting these days is to get to your boat at a weekend, and to get home afterwards, and still leave a piece of weekend in the middle. With an aeroplane things are usually greatly simplified, and cruising grounds which are normally only possible during the annual holidays become within reach all through the summer.

But everything turns on landing grounds. Apart from the Royal Corinthian at Burnham before the war, I know of no yacht club that has near it a landing ground close enough to the sea for practical purposes. The RAF is unco-operative, especially at weekends. Ipswich is probably the best, but what a chance for a flying club to start a yacht station, or a yacht club a flying field! And what a halcyon weekend a member of the Seaplane Club might have if he could land his light aeroplane within easy reach of the seaplane base, and spend his spare time sailing. Apart from the addition of a few dancing girls if you are inclined that way, you could scarcely ask for more.

★ ★ ★

Notam No 51 is going to give private pilots something to think about—if they can understand it. It appears to mean that, apart from entrance funnels into and the circuits of Fair Oaks, Denham and White Waltham, the whole of the London Control Zone, which covers over 250 square miles of the most valuable and important part of England from the ground to 11,000ft—about 2½ billion cubic yards of air—has been appropriated by the Ministry for the benefit of one section of the community, i.e., those who travel by scheduled airlines. By what right they do this they do not explain. To say, as they do, that private pilots may be allowed to cross the zone if they have radio, if the traffic permits, and if the controller happens to be in a good mood, does not alter the fact that an enormous area of airspace has been filched from the general flying public.

No doubt they excuse themselves on the grounds of safety. Private pilots would be perfectly happy to keep below 1,500ft and well away from London Airport so that airliners could take off, land, and get on their way without looking out at all, and still be quite safe. But the wretched private pilot is not considered at all, and his country's air, which I suppose he pays for like other taxpayers, is stolen from him for the doubtful benefit of the already subsidized national airlines.

Yet, talk to the average airline captain. I know a number of them. Some fly light aeroplanes as a hobby and for relaxation. Not one of them will tell you that he has any serious worry about the infinitesimal risk of colliding with a blind man flying a little aeroplane. Indeed, all the statistics prove that when you take off on a scheduled flight, whatever your chances may be of coming to a sticky end, they are certainly not affected by the risk of hitting a little aeroplane.

"A member of the Seaplane Club might spend his spare time sailing. . ."

Recently I went on a trip to Australia, in the course of which we circuited the globe, mostly in giant jet airliners. Any public anxiety, I noticed, apart from when the next meal was due, was caused entirely by the strange noises set up by the flaps, the wheels going up and down, and the reverse thrust on landing. The public instinct, which I think was right, was that here was a highly stressed piece of machinery which might easily go wrong. We never saw a light aeroplane, and it never crossed our minds that we might.

Elephants, I suppose, can be scared by fleas, but it is scarcely up to our Ministry boys to pander to these fears, even if they exist, which I don't believe they do.

On the legal question of the freedom of the air, and who owns it, no doubt it is a question which our jurists will be thinking about. I have a house and a bit of land in the London Control Zone. Do I have any rights to the air over them, I wonder?

What a pity it all is. Those of us who fly regularly know that there is plenty of room for everybody in the air, and that we can all enjoy it and go about our business without interfering with or endangering our neighbours. All we need is a little common sense, tolerance, and knowledge of the job.

NOW FLYING IN FRANCE is a novel home-built helicopter powered by 65 h.p. Salmson engine. Main points of interest are that the rotor has no cyclic-pitch control, and that lateral control is by displacing the rotor centre sideways by tilting a parallelogram mounting. Fore-and-aft control is by fore-and-aft tilting of the rotor axis. Collective pitch is presumably variable. Tail rotor pitch is also fixed, thrust variation being achieved by tilting the plane of the rotor on a horizontal axis. An indistinct photograph appears to show a multi-belt drive from the horizontally mounted engine to the base of the main-rotor shaft, with a straight shaft from the rear of the engine to the tail rotor. The designers consider that single and two-seat versions, respectively with 90 h.p. and 110 h.p. engines, could be made quite cheaply. Gross weight of the present prototype is between 350 and 360kg.

JAMES HAMILTON has been appointed chief flying instructor to the Herts and Essex Aero Club at Stapleford Aerodrome, in succession to Neville Browning. Mr Hamilton, formerly CFI of London Aero Club at Panshanger, has 7,000 hours' flying experience, including 5,000hr as an instructor.

The Herts and Essex Aero Club has adopted as its motto a Latin translation of the slogan "The Sky is our Playground" by the

Designed by L. K. Heuberger of Los Alamitos, California, this novel delta two-seater is being built in Mr Heuberger's garage in the suburban surroundings here depicted. The aircraft is powered by a 125 h.p. Lycoming and will incorporate folding wings

twelve-year-old winner of a competition held in conjunction with a local newspaper, the *Ilford Pictorial*. The prize for the winners was a visit to the club and a local flight.

STATEMENTS made in recent weeks by spokesmen for this country's gliding movement have indicated clearly that the future of Lasham Gliding Centre is now safe. The old bogy of insecurity of tenure has apparently been laid—not with the purchase of the aerodrome, as the gliding fraternity desired, but on the basis of a lease over a not-unreasonably-short period.

Speaking at the British Gliding Association ball on March 10, Air Chief Marshal Sir Theodore McEvoy said: "An announcement will be made in May regarding Lasham. The outcome may not be as hopeless as many had feared." In the BGA chairman's report presented at the association's annual general meeting on March 11, Mr Philip Wills stated: "On the major issue of Lasham, our efforts . . . seem likely to bear fruit, and at last we may hope for a solution which will enable us to pursue our major ambition to build this into a Commonwealth gliding centre . . . There is a feeling abroad that at last the Powers that Be are willing to help beyond the merely negative sense of leaving us to be our own masters and of verbal encouragement." And in the Royal Aero Club chairman's report presented on March 22, Col C. F. H. Gough commented: "I am glad also to report that there is every hope that Lasham will be able to continue on a long-term basis as a Commonwealth gliding centre."

It is understood that a 21-year lease on Lasham Aerodrome (with the exception of the section used by the Royal Aircraft Establishment) will be offered, with perhaps an option to extend to 42 years. It is hoped that the lease will be held by the Shaw Slingsby Trust. The offer of a lease follows the failure of negotiations to purchase the aerodrome from the Air Ministry. At the time the purchase was being considered, a special appeal to Lasham members raised the excellent figure of over £17,000, but this was not sufficient to meet the Ministry's price. Leasehold negotiations have since been carried on with the Ministry of Aviation.

THE SHORTAGE OF PILOTS for all types of flying jobs in New Zealand has led indirectly to the establishment of a specialized agricultural flying school. In the five weeks up to February 26 five top-dressing pilots were killed in accidents, and a statement issued by the Chief Inspector of Aircraft Accidents, Mr O. J. O'Brien, reported that four of the accidents were caused by pilot error and inexperience.

The accident details, with the chief inspector's comments, are:—

January 31, Piper PA-18A stalled on take-off, crashed and burnt out, pilot killed. Comment: "The main factor here was inexperience; the hazard was created by the pilot himself."

February 5, Fletcher FU-24 dived in vertically, pilot killed. Comment: "The pilot lost control when elevator cable was cut through by a screw jammed in the pulley. The aircraft was inspected thoroughly only three days before the crash. The screw would have cut the cable in five to 10 hours' flying time."

February 9, Piper PA-18A's engine failed on take-off. Pilot killed. Comment: "The aeroplane had just been refuelled in the starboard tank. The pilot forgot to switch fuel from the port tank, which had just enough fuel to get the aircraft into the air. Here was a combination of mismanagement of the fuel system and an element of inexperience."

February 16, Piper PA-18A struck high-tension power line. Pilot killed. Comment: "The pilot was experienced. He was flying down the valley looking for a truck. I assume he was preoccupied with the job and did not see the solitary wire which he forgot was there."

February 25, Piper Pawnee stalled and spun on take-off. Pilot killed. Comment: "Here was an element of inexperience. The high altitude of the strip (2,000ft) and temperature (90°) contributed by making the engine sluggish."

The shortage of trained pilots became so acute recently, a New Zealand correspondent writes, that a special inquiry into the problem was set up by aviation interests in the Dominion. Representatives of the National Airways Corporation, Royal New Zealand Aero Club, the Aviation Industries' Association, and Tasman Empire Airways attended the meeting. No findings have yet been released, but reliable sources throughout New Zealand have indicated that facilities and methods of encouraging young potential pilots to enter commercial aviation are inadequate.

As a result of the shortage many aerial-work operators have been hiring newly fledged commercial pilots who have not had sufficient experience to embark on this specialized work.

Last year's top-dressing accident figures were reduced to an all-time low of two accidents per 10,000hr, but, if the present trend for this year continues, the pilot shortage is likely to be greatly aggravated.

INFORMATION from all sources is being sought by the Association of British Aero Clubs and Centres in order to compile a register of aerodromes and landing grounds suitable for light aircraft in the United Kingdom. The location of such fields, together with the name of the owner or controlling authority, should be sent to the ABAC at 7c Lower Belgrave Street, London, SW1.

CURRENT BRITISH PRICES of the four main models of the Aero Commander, including delivery charges and import duty, are quoted by the UK representatives, Field Aircraft Services, as follows: Model 500A, £29,426; Model 500B, £35,300; Model 560F, £42,434; and Model 680F, £48,730, and not as given in our March 23 issue.

THE UMBAUGH 18 AUTOGIRO is expected to be on sale in this country later this year at a price of £4,200, according to Mr I. G. Shrigley, managing director of Holman & Co of Glasgow, who have a United Kingdom concession for the type. During this month Mr Shrigley is visiting the USA for instruction on the type, and a demonstration aircraft is expected at Glasgow.

AN L-200 MORAVA is currently engaged on a world sales tour. The aircraft left Prague last month and will be visiting Jugoslavia, Greece, Egypt, countries in the Near East and Far East, Australia, South America and North America.

Following the Royal Aero Club annual general meeting on March 22 a number of club awards were presented by Lord Brabazon: from the left, M. Charles Marchetti of Sud Aviation receives the Louis Breguet Memorial Trophy; V. H. Bellamy, Geoffrey de Havilland Trophy; Sgt John Williamson, Bronze Medal; J. M. Houlder, Bronze Medal; B. F. Collins, Bronze Medal

Thermalling over the "Big Hole" at Kimberley—site of the original Kimberley diamond mine; a picture taken from the Skylark 3 by Denis Burns during the South African visit here described

SPORT AND BUSINESS...

DIAMOND COUNTRY

BY DENIS BURNS

AT the invitation of Boet Dommisse, the current South African gliding champion, my wife and I were able to fly Boet's exceptionally well-equipped Slingsby Skylark 3b during the performance camp held at Kimberley Airport, Northern Cape Province, at the beginning of this year. The camp was attended by a large number of club members and private owners and, as the following outline indicates, the meeting was a phenomenal success.

January 3. Mrs Anne Burns flew to Volksrust in the South-east Transvaal, a distance of 320 miles. This completed her diamond badge and she became the fourth British pilot to gain this distinction. Tim Biggs of Johannesburg Soaring Centre flew the same course in an Air-100 and became the third South African to achieve the coveted three diamonds.

January 5. Herby Oberhofer in a Ka-6 of Cape Peninsula Gliding Club made a diamond goal flight to Alanridge, some 200 miles to the east in the Orange Free State.

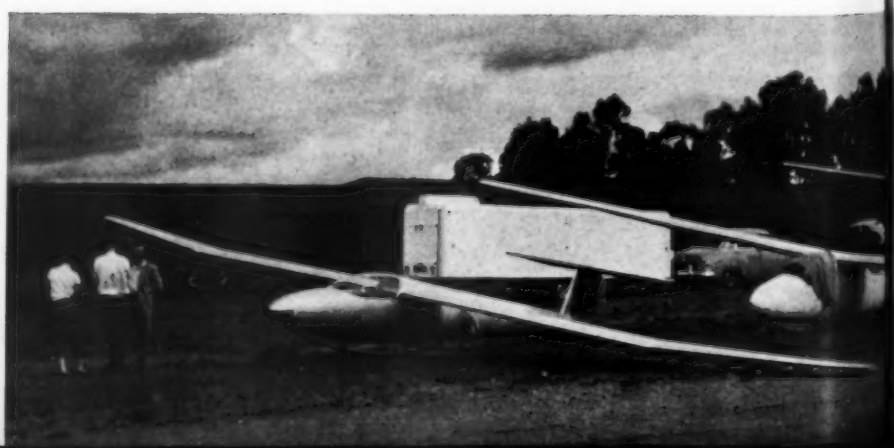
January 7. I attempted the British out-and-return record by flying to Theunissen (Orange Free State) and back, a distance of 244 miles. The attempt just failed by about one mile.

January 8. Mrs Burns flew a feminine world 300km closed-circuit speed record, with turning points at Christiana Railway Station (Transvaal) and Dealesville Church (Orange Free State). This record was previously held by Poland.

January 9. Bobby Clifford of Johannesburg SC in an Air-100 broke Dommisse's South African out-and-return record by flying to De Aar, Cape Province, and back (some 270 miles). Mrs Burns completed the same task and thus beat the British record and the feminine world record held by Russia. Eddie Leeman of Johannesburg SC essayed the world record out-and-return to Vermaas (Transvaal) and back, and only just failed by 20-odd miles.

Map showing the main flights described in the article. The retrieving journey from Kimberley to Volksrust, after the flight which completed Mrs Anne Burns' diamond badge, is shown dotted

The Beatty-Joel BJ-2 high-performance sailplane, here seen at Kimberley in front of a Skylark 3, incorporates a cranked wing, T-tail and fuselage air-brakes



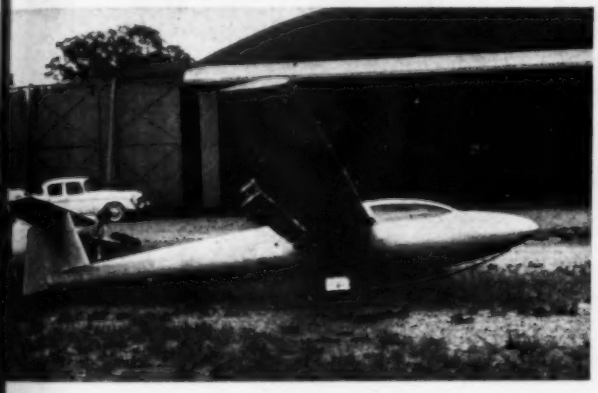
January 10. Heinie von Michaëlis, an erstwhile South African champion, beat Clifford's record of the previous day by flying in a Ka-6 to Hanover (Cape Province) and back, a distance of about 320 miles. This also earned a distance diamond for his gold badge. At the same time I flew out to, and returned from, Westleigh Railway Junction (just north of Kroonstad in the Orange Free State), a distance of 352 miles, thus beating Dick Schreder's world record out-and-return of 338 miles and the British record put up by Anne the previous day.

January 11. Anne Burns beat the feminine world 200km closed-circuit speed record, previously held by Poland, in a flight with turning points at Content (Orange Free State) and Koetsrus (Orange Free State). This flight also beat the British record. Tim Biggs beat the South African 200km closed-circuit speed record, and Geoff Lloyd beat the South African 300km closed-circuit speed record but unfortunately was not officially timed.

January 12. I made an altitude flight from Kimberley to approximately 22,000ft a.s.l., gaining my diamond height and becoming the fifth British pilot to achieve the three-diamond badge.

Right, retrieving scene on the pass over the Drakensberg from Natal to the Orange Free State on the return journey from Volksrust

Below, a side view of the BJ-2, showing its Fowler-type flaps and the ingenious fuselage air-brakes in the retracted position



January 13. Bobby Clifford gained his height diamond by climbing to 22,000ft a.s.l. Anne broke the feminine world gain-of-height record and exceeded the British record with a climb of some 30,000ft, finishing at an absolute altitude of approximately 35,000ft a.s.l.

This sequence of record flights, including five world records in six days, obviously could not have been flown unless the conditions were superb, but a few detailed comments on the weather might not be out of place. The diamond distance flights made by Mrs Burns and Tim Biggs on the 3rd were made on a day immediately following 24hr of steady heavy rain. We assumed that the next day, marked already at 10 a.m. by dappled cumulus as far as the eye could see, was merely "a good day immediately following a cold front." There was a good 12-15kt wind blowing across the Free State from west to east, and the flights achieved were clean across the whole of that province and just into the Transvaal, at speeds well over 50kt.

Both pilots landed virtually together at 5.30 in the shadow of Majuba Mountain at the start of the Drakensberg. The thermals had died completely—diamond distance had been just possible, and no more. Cloudbase this day was not very high, increasing from about 2,000 to 6,000ft above ground, and the cumulus was worth working, with climbs of 4,000-5,000ft here and there. Lift averaged 3-5m/sec during the middle portion of the day.

The retrieve was fantastic, taking us through all four provinces of the Union (see map) and involving about 1,200 miles of trailering and four mountain passes—all carried out over superb national roads at a speed that would be quite impossible in crowded England. We arrived at Volksrust at one o'clock in the morning after leaving Kimberley at midday, having completed 600 miles of high-speed trailering with long stretches at 70 m.p.h. A stop was made on the way for a celebration four-course dinner laid on by Boet Dommisse to celebrate the third and fourth South African and British Diamonds.

The next three days' weather was very similar, with perhaps the thermal development not so strong. Goal flights of 300km, but not 500km, were possible. With the wind still strong from the west, the pundits (who all had their 300km goal diamonds) were hard pressed for suitable tasks, since closed-circuit speed tasks and out-and-returns were judged too difficult because of the prevailing wind.

On January 7, I decided to break this deadlock with an attempt on the British out-and-return record. The day possessed entirely clear-air thermals with no cumulus whatever. The plan was to fly fast downwind to Theunissen in the middle of the Orange Free State, and to return rather more slowly at first, but faster as the wind abated towards evening. The only thing that went wrong was that the wind did not die down, and so the flight out took two hours (at about 60 m.p.h.) and the return four hours. The westerly 15 m.p.h. wind lasted until sundown and I was forced to land just short of Kimberley Airport.

The next day, spurred on by the thought of what the lift must have been like for her husband so nearly to succeed the previous day, Anne stoutly declared a 300km triangular speed dash, despite a steady 12kt wind. She achieved a world record of some 42 m.p.h. by dint of concentrating on getting the maximum rate of climb out of every thermal, and quitting climbs that were not up to 3m/sec. This flight was, perhaps, the best technical performance of the whole meeting.

On the following day everybody was up bright and early, eagle eyes scanning the horizons for the appearance of Boet's promised "high cu" that would presage world record-breaking weather of a high order. This did not materialize and, furthermore, a brisk 12kt wind blew from the north. Hasty consultations with maestros Dommisse and von Michaëlis hatched the plan of a cross-wind flight due south to De Aar in the Cape Province and back again to Kimberley, in the hope that the north-westerly wind would die down as the day wore on.

The plan was no sooner hatched than Bobby Clifford and Anne were off and heading for De Aar. The clear-air thermals proved very strong and rough but the wind did not die down to the extent predicted. Nevertheless both pilots completed their tasks with the record-breaking results stated. Towards the latter part of the day small cumulus did start to appear very high and climbs to 16,000ft a.s.l. were possible before conditions died. Eddie Leeman, of the Jo'burg SC, in the other Skylark 3 struck an independent attitude this day and nominated Vermaas Railway Junction, Transvaal, to the north-east as his turning point for a world out-and-return record attempt. He therefore had to fly cross-wind out and back, and only missed Kimberley Airport by 20 miles. This was a truly magnificent effort by a young pilot who is probably South Africa's future champion.

On the next day, January 10, the fabulous conditions promised by Boet Dommisse did arrive and von Michaëlis and I achieved the records previously noted. Again the wind had a northerly component but this time it faded by midday, and this made all the difference. Von Michaëlis' choice of route south into the Cape

SPORT AND BUSINESS...

Panel blown out of Anne Burns' Skylark 3 wingtip by lightning during the climb to an altitude of 35,000ft

Mrs Anne Burns (centre), seen together at Kimberley with Boet Dommisse, Mrs Debbie Dommisse and bottle of celebration refreshment

DIAMOND COUNTRY...

Province and back was the better. This route is over very inhospitable dry terrain and produces extremely strong thermals because of the very dry air. Flying the north-easterly route over the hospitable Free State farmland, I did not experience such strong thermals. Von Michaëlis was able to fly for considerable periods under high cumulus streets at about 12,000-14,000ft a.s.l. and his average speed was considerably faster than my average of 42 m.p.h.

I set course for my final glide into Kimberley Airport from 60 miles out, near Dealesville in the Orange Free State, calculating that I would have 1,000ft to spare at Kimberley. In the event, at 7 p.m., I flew in to such smooth lift on the glide-in that it would have passed unnoticed had I not, for a moment, shaded my eyes from the dying sun to look at the climb meters. This last thermal carried me to 16,000ft a.s.l.—which must be a world record for an evening thermal. With 6,000ft in hand, I arrived over the airport, where a mayoral celebration was awaiting. During this flight Boet Dommisse's "high cu" started before midday on the way out, and cloudbase kept getting higher as the day wore on.

200 km Triangle

The same magnificent weather continued on the following day, with very high cumulus marking the tops of the thermals. As there was only a light wind, Anne showed how good the Skylark 3 can be by rattling round a 200km closed circuit in world record time at nearly 50 m.p.h. She did not use the clouds much. At this speed one needs to be well strapped-down during the high-speed inter-thermal glides as the turbulence can be quite exciting.

By the next day, January 12, it was evident that the weather cycle was changing, as cloud development was much greater and cloud base was lower. The clouds looked better than they in fact were, and considerable search was necessary before a suitable one produced an internal 8m/sec to rocket me up for my diamond height. Accurate centering in this cloud was necessary in order to retain the lift, but the flight otherwise was easy and a delightful experience. Icing was quite heavy, but the dive-brake did not freeze in and the only noticeable effect was a slight heaviness on the elevator.

The following day—Friday the 13th—continued the tendency of the weather cycle to give over-development and Mrs Burns proceeded to achieve a cu-nim height gain that has only once previously been exceeded, and then only by a small margin. This weather the South Africans call "cumulus colombus," and it requires treating with respect. Mrs Burns entered cloudbase about 6,000ft above ground in one of several clouds that were visibly growing in size. On the way up, the glider rapidly acquired an electrical charge, with discharges occurring from the pilot's knees to the radio set, and the metal parts of the control column and of the rudder bars being unpleasantly tingly to the touch.

At about 34,000ft a.s.l. a nearby major strike induced a further charge on the metal portions of the glider which it could no longer store, and it discharged itself violently through various portions of the left wing into the cloud. Anne was temporarily confused by this shock but, coming-to more or less instantaneously, checked the oxygen and decided it was time to get out of the cloud. Further height was gained on the way out, and she switched on to pure oxygen as a precaution (the rate of climb indicated that the altitude at which pressure breathing was required was rapidly approaching, and pure oxygen was the next best thing). The pilot's view from this altitude of surrounding "cumulus colombi" was astoundingly beautiful. By this time a major storm had become centred over Kimberley Airport, and the lightning activity there made the pilot decide on a precautionary field landing out in a small clear space between the thorn trees and ant-heaps some 14 miles to the east.

So ended the Kimberley Performance Safari 1961—for my wife and I, at least. We trailered Boet's glider immediately back to Jo'burg that night (300 miles) in order that a quick repair to the lightning-struck wing might be started.

Monster Ant-heaps

A few comments on field-landing conditions in South Africa may be of interest. The terrain immediately round Kimberley, for about 20 miles, and to the west (into the Kalahari) and south (into the Cape Province) is not good, comprising for the most part thorn trees with a liberal spread of monster ant-heaps. However, in these directions the dry air is very good for vertical development and experienced pilots should have no difficulty in finding the odd landing spot. To the east is the whole run of the Orange Free State; one vast farmland, and surely the glider pilot's dream of heaven. To the north-east into the Transvaal there is also cultivated land as far as about the latitude of Pretoria. Beyond that to the north, and further to the east, the terrain is not so good, consisting of "bushveld" with little arable land.

As regards gliders, the two Skylark 3s had much competition from the Air-100 and the Ka-6s during the meeting. The latter performed exceptionally well. The two-seater Ka-7s did very well but were not quite up to the standard of the Skylark 3s and the Ka-6s.

In conclusion, a few remarks on South African gliding personalities will complete the picture. Boet Dommisse (unable to fly throughout the rally as he had promised us his glider) is the great moving spirit of South African gliding—organizer, expert pilot and wise counsellor. Without his drive, generosity and advice we, at least, would have fared ill. His wife Debbie is his able supporter, attractively cheerful at all times, even when gloom has descended on the rest of the retrieve crew. Heinie von Michaëlis is South Africa's great naturalist and artist. He combines this with being an expert sailplane pilot and raconteur. Supporting these two is a solid cross-section of South African citizenry, typical of whom, perhaps, is the droll Tim Biggs, skilled engineer and aviator, who seems never at a loss in any situation.

As to future possibilities, fresh records may well go to the ingenious BJ-2 sailplane just finished by Pat Beatty in Johannesburg. This new glider has a phenomenally flat glide at 90kt and yet will thermal happily at 30kt—all done by varying the geometry. If there are no snags, this glider is a potential world-beater.

Footnote: After surprisingly rapid confirmation by the FAI, five world record certificates were presented to Anne and Denis Burns by Philip Wills at the British Gliding Association ball in London on March 10. Mrs Burns received those for feminine gain of height, out-and-return distance, and 300km and 200km speed; and Mr Burns that for out-and-return distance.

MARCONI DOPPLER

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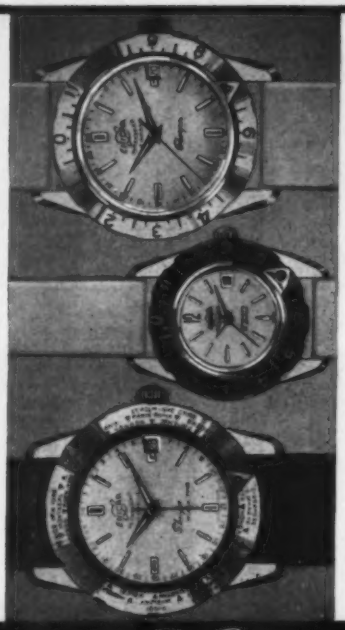

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CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. The names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Comet Crew Workload

YOUR comment "Three Pilots, Four Sectors" (Air Commerce, March 10) seemed to me a masterpiece of innuendo. For the uninformed it conjured up an impression of overpaid, overcrewed but underworked BEA pilots refusing through sheer laziness to fly four sectors a day in the Comet.

What these pilots have been resisting has been the unsafeguarded application of the scheduled four-sector day, which is quite a different matter. Remember that the four-sector schedule will sometimes result in a five-sector day. A jet landing is far more critical, in terms of alertness required, than was the case in propeller aircraft, and it is the safety of that last landing of the day or night that must be the main consideration.

Your comment implies that the issue is affected by the fact of there being three pilots on board, without mentioning that this third man is at the engineer's panel. It also implies that the increase in BEA's cost-level is mainly attributed to pilot pay increases, a suggestion open to dispute. It is even wrong in implying that good flying weather should improve utilization; by eliminating holding and let-down procedures it actually has the opposite effect, although the plan must be for the worst likely weather.

BEA are, of course, right to try for high utilization, but their pilots are equally right in resisting attempts if they feel they border on the dangerous.

Hong Kong ANOTHER JET PILOT

[We did remark that: "The upward trend in BEA's cost level is of course not wholly attributable to increases in the pay of their pilots." As we go to press it is learned that the disputed working conditions are to be examined by the Flying Personnel Research Committee of the Air Ministry—Ed.]

Export Opportunity

WITH the disbanding of the East German aircraft industry, the LOT (Polish Airlines) order for the VEB-152 jet transport has fallen through.

I am a layman, both in aviation economics and Iron Curtain politics, but I seem to remember the old maxim "Where there's a will, there's a way." Therefore, an export drive on Poland's airline (and other East European carriers), by Vickers and de Havilland might result in big orders for the Vanguard and Comet. Besides earning cash for Britain, the sight of our aircraft in unusual colours would warm the hearts of all true Britons interested in the sales of home-made goods to overseas markets.

London NW6 ROBERT CARR

[Although the LOT order for the VEB-152 was never firm, our correspondent's proposal for an export drive in East European countries is a timely one. We can assure him that this market is not being overlooked by British manufacturers.—Ed.]

Private Flyers' Seventh Heaven

I HAVE just bought my first copy of your excellent publication *Flight*, dated February 17. The first thing that caught my eye when I opened it was your leading article, "Freedom Under Control." You say: "The problems of sharing aerodromes and airspace between commercial and private users are too complex to be solved without a generous helping of imagination from the bran-barrel of new ideas." Balderdash!

I thought your leader-writer and the poor unfortunate private pilots in the British Isles would be interested in an experience I had here in the USA this past winter. A friend wanted to pick up an airline ticket at Greater Buffalo International airport, which is about 20 miles by road from here through heavy traffic. It takes about two hours for the round trip by car, but less than ten minutes by Tri-Pacer from Niagara Falls Municipal airport—each way, that is; and as the Tri-Pacer was parked only a hundred yards from where we live we elected to fly. After a thorough pre-flight check I called Niagara Falls tower and received take-off instructions. The wind was out of the west at 10kt, the time was 8 p.m., and a cold front was expected through about midnight. After an uneventful take-off, and after leaving the NF tower-frequency, the conversation went something like this:—

"Buffalo tower, this is Tri-Pacer nine three seven Alpha over North Tonawanda [ten miles out] landing Buffalo International."

"Three seven Alpha, contact approach control on one one nine point eight."

"Buffalo approach control, this is Tri-Pacer nine three seven Alpha over Tonawanda, landing Buffalo International."

"Tri-Pacer nine three seven Alpha, this is Buffalo approach control. How would you like to do a radar surveillance approach tonight?"

"We'd be glad to do a practice radar approach."

"We think we have you on radar; turn to a heading of nine zero degrees for positive identification."

"Heading nine zero degrees. Altitude three thousand."

"Turn to a heading of one four zero degrees."

"Heading one four zero degrees."

"Turn to a heading of two three zero degrees, descend to two thousand five hundred . . .

"You are now seven miles from touchdown, complete your final cockpit check at this time, altimeter two niner niner zero, wind west south west gusting twenty-five. Field elevation seven one one."

"Understand."

"You are now five miles from touchdown. Start your descent, do not acknowledge any further transmissions, if there is a break in transmission of more than thirty seconds execute a missed approach and proceed to make a normal instrument approach . . . Your altitude should be two thousand feet, you are now three-and-one-half miles from touchdown, change your heading to two hundred and twenty-five degrees . . . You are now two miles from touchdown. Your altitude should be one thousand five hundred, heading two two seven degrees . . . You are now half-a-mile and five hundred feet off the end of the runway. Take over visually from this point. Thank you for your patience, and if you boys would care to see how we operate come on up to the tower."

This invitation we gratefully accepted after getting taxi instructions from ground control and parking next to the American Airlines DC-6. My friend got his ticket and we went to see how the radar boys were doing. They told me that if it were not for the little fellows like me they would have a hard time staying active, as they have to do a required number of practice approaches each month and the big ones are usually too busy to be bothered. When the operator showed us how the 50-mile radar screen looked we could see that that cold front would be here long before midnight, so we decided to waste no more time in getting home. Incidentally, there were never less than eight aircraft within a ten-mile radius of the field, and sometimes as many as 12, mostly commercial airliners.

We got taxi instructions to follow a Capital Airlines Viscount to the active runway as we had no landing light, only navigation lights (this being an older model Tri-Pacer). Keeping a respectful distance behind the big bird we heard him get take-off clearance, then came take-off clearance for an American Airlines Electra that had snuck up behind us.

We heard the Electra pilot say: "How about this little fellow up front here, it's kinda stormy for him out tonight, isn't it?" We wholeheartedly agreed by this time, for it was gusting 45kt. We got our clearance and the Tri-Pacer fairly wanted to jump into the air. I held her down until the airspeed hit 80 before easing her off. The wind was tossing us around like a cork and the next thing we hit was the rain. We had got clearance to the inner marker, where radar was supposed to take over again, but as soon as we had cleared the runway radar took over and gave us a steer direct to Niagara Falls. What a wonderful way to travel!

Or take the night I called my good friend the airport manager in Massena, New York. I had already checked the weather, intending to fly to Massena the next day. It was clear all over the whole eastern United States. That conversation went like this (it was 8 p.m. Saturday):—

"Hello, Stan, what are you up to?"

"Hey man, what are you doing? Your old buddy Gordon just flew in from Philadelphia."

"Well, what are you going to do tonight?"

"Why, we're going out."

"Well, hold on, I'll be right there. See you at the airport at about eleven."

"Okay, we'll wait for you."

It's almost 300 miles to Massena from here. After the usual pre-flight I was ready to go. Incidentally, if there had been anything I had needed, like petrol, this would have been no problem as Niagara Falls Municipal is open 24 hours a day, as are most other major airports. Take-off clearance at 8.15 and I filed a flight-plan by radio. The Tri-Pacer was climbing like a homesick angel tonight, and I reached my cruising altitude of 5,500ft in a few minutes. Soon I was within reach of Rochester radio and gave them a position report.

Rochester VOR was out of order, but that was no sweat. I could see for 60 miles or more; the only thing that worried me was ground fog, and I asked for a report on the latest temperature and dew-point figures from Massena as soon as they came in. I was 40 miles out of Rochester when I got the information that there was only two degrees between temperature and dew-point at Massena and that surface wind was only four. As this added up to possible ground fog I started to plan an alternative airport. I decided that if

CORRESPONDENCE...

the situation was any worse when I got to Watertown I would land there for the night, but by this time Syracuse radio was calling Tri-Pacer 937 Alpha.

They want to know my position and the weather in my vicinity—if there is any. It's clear as a bell and my position is over Oswego on the eastern shore of Lake Ontario (I had skirted the lake as it is a prohibited area and, anyway, it's poor policy to fly over open water with only one fan out front, even if it is at night. Soon I sign off the Syracuse frequency and tune in Watertown. I have just got the signal when Watertown radio calls with the latest Massena weather. These boys just can't seem to do enough for me tonight. Temperature and dew-point have spread to three degrees, so I decide to go on. If it closes in at Massena I have plenty of petrol to go on to Plattsburg, Burlington or even Montreal.

I'm doing real good tonight, getting almost 135 for ground speed, and the next thing I know it's time to call Massena radio. As I get closer they tell me to be on the lookout for an Eastern Airlines Martin 4-0-4 in the area. Soon I see him and hear him get clearance to land, and by now I can see the runway lights and the Martin on final. It's my turn next. If I had got there first it would have been his turn next; the big boys have no preference over the little ones here. (As one airline pilot put it, "After all, we didn't learn to fly in these monsters.") Three hundred miles in two hours 15 minutes. What a wonderful way to travel!

I just can't imagine calling up a friend in London from my home in Limavady, Northern Ireland, and saying "Hold on, I'll be right there." You see, I'm not a native American and I complain as much as anyone about the few restrictions the FAA impose on us here; it's not until I read a magazine like yours that I realize just how lucky we are.

I only hope that one day you will be able to enjoy flying half as much as we can here in these United States. By the way, what's a landing fee? In all the flying I have done here I have only paid a landing fee once—at St John, Quebec, Canada, 3s 6d. Any of our airports that have landing fees only apply them to executive light twins or in some cases to aircraft over 3,000lb gross.

If you want to you may feel free to print all or any part of this letter. I learned to fly at Massena, New York, took my first lesson on December 22, 1957, and got my Commercial Pilot's Licence on September 13, 1959.

Lest any of your readers get the impression that these flights I have described could only have been accomplished by a commercial pilot with an instrument rating, they are wrong; I don't have an instrument rating. I do have the ten hours' instrument time and the ten hours' night time required for a commercial ticket; but these requirements are for safety—there is no substitute for a good eye and a swivel head.

To quote from an article by General Quesada, former administrator of the FAA:

"Today there are more than 109,000 planes aloft in the USA including 170 civilian jets, 70,000 other private and business planes, and 30,000 military aircraft. During 1959 towers operated by the FAA handled more than 27 million landings and take-offs. On any given day the air is crowded with as many as 8,000 at once."

Yet it is over ten times safer to travel by air than any other means of transport. Sure, we just had a big disaster over New York, but we kill more people on the highways on one holiday weekend than in the air in a whole year. More people die from slipping in their bath-tubs than in the air; but I haven't heard any outcry to make bath-tubs safer. I wonder if your officials don't feel just a little bit foolish when they see figures like I have just quoted. Or don't they believe them?

Niagara Falls, NY — AUSTIN HARBINSON

[What may be balderdash to Mr Harbinson (paragraph 1) is not balderdash to us, nor is it balderdash to Britain's private pilots, whose "share-the-airspace" lobby is still a feeble one. It is new ideas, such as those for transition control zones, recently implemented in France and in the USA, that *are* needed if private flying is not to be nudged out of Britain's crowded air. Anyway, Mr Harbinson, thanks for taking us along in the Tri-Pacer.—Ed.]

London Heliport Sites

UNDER the heading "Brevities" on page 385 of *Flight* for March 23 you state (quoting the *Daily Mail*) that "The Minister of Aviation has decided that Cannon Street Station is to be developed as London's major heliport."

This statement is incorrect, as enquiry of the Ministry of Aviation will confirm. Cannon Street Station is only one of three sites recommended to the Minister of Aviation by the Interdepartmental Committee on the Location of London Heliports as being "operationally suitable"—the others being Nine Elms Goods Yard (in which this company has an especial interest) and St Katherine's Dock.

No final decision has yet been made; indeed the committee is precluded by its terms of reference from making a decision—it can only make recommendations to the Minister as to site suitability and other factors, and to date it has not yet finished its work. Having made an interim report to the Minister recommending the announced three sites as being operationally suitable, the committee is now looking further into detailed matters in respect of these three sites before reporting further to the Minister in order that a final decision may be made.

Your readers will be interested to note that this company is continuing with its efforts to bring the Nine Elms site into operation as soon as possible as London's first public-use heliport.

London W1 — ROTORPORTS LTD, Henry M. Berney

THE INDUSTRY

Sealing VC10 Tanks

WHAT is described as "the first aeroplane-wing rotating unit (technically, a torque-box manipulator)" to be built in the United Kingdom has recently been put into operation at the Weybridge factory of Vickers-Armstrongs (Aircraft) Ltd. It is being used in the process of sealing VC10 fuel tanks.

Designed by Matterson Ltd of Rochdale, Lancs, and built in association with Yates Plant, a subsidiary of Baker Perkins Ltd, the unit cost approximately £18,000. The manipulator consists basically of two steel rings, 18ft in diameter, mounted vertically on rollers recessed into the floor of the shop where sealing takes place. The rings are so placed in relation to each other that they form a rotating cradle in which the centre section of the aircraft wing, containing the fuel tanks, is clamped. The cradle-driving units are an adaptation of the standard heavy-duty rotators manufactured by Yates Plant for welding manipulators. Hydraulic motors are used for ease of control and to obviate flameproof electric gear.

After air tests for leakages have been carried out, liquid neoprene rubber is pumped into the tanks and the cradle rotated, so that the rubber coats the inner surfaces. When rotation is complete (taking approximately 6min for three revolutions) the excess rubber is withdrawn, leaving a film to seal the tank interior.

Technical director (guided weapons), Hawker Siddeley Aviation Ltd: Mr G. C. I. Gardiner, CBE, MIMechE, FRAeS, whose appointment was referred to in a news-item last week

Bryans Aeroquipment Ltd, Willow Lane, Mitcham Junction, Surrey, have published a brochure describing their "X" and "Y" co-ordinate plotting table and point plotter and the various applications.

English Electric Valve Co Ltd, Waterhouse Lane, Chelmsford, Essex, have published a comprehensive illustrated brochure, *By Precision to Perfection*, describing their facilities and activities.

Hughes International (UK) Ltd, who produce a wide range of semiconductor devices at their plant at Glenrothes, Fife, Scotland, have been granted AID approval by the MoA.

An illustrated brochure has been published by Ultra Electric (Holdings) Ltd, Western Avenue, Acton, London W3, describing prospects and training schemes for school-leavers and students in the Ultra companies.

Research & Control Instruments Ltd, Instrument House, 207 King's Cross Road, London WC1, sole distributors in the UK for Philips welding electrodes, recently assisted Vickers-Armstrongs (Aircraft) Ltd with a new method of jig fabrication for the VC10 by metal arc welding.

Mr H. W. G. Hignett and Mr Jean M. Dhavernas have been made directors of the International Nickel Co (Mond) Ltd. Mr Hignett remains managing director of Henry Wiggin & Co Ltd; Mr Dhavernas is located in Paris and has been closely concerned for many years with nickel markets on the Continent.

Two directorships have been announced by the Esso Petroleum Co Ltd. Mr E. F. Choppen rejoins the board on April 4 after a year's assignment with the Standard Oil Co (New Jersey) in New York; and from the same date Mr L. B. Johnson, London-based European financial representative for Standard Oil Co (New Jersey) since 1957, also becomes an Esso director.

Mr R. F. G. Hamilton, BSC(ENG), MIEE, has been appointed manager of the servo components division of Elliott Brothers (London) Ltd, a member of the Elliott-Automation Group. He succeeds Mr D. Ince, who is taking up new duties within the group. Mr Hamilton became technical manager of the Servo Components Division early last year.

"Routine talks" was the reason given for the departure on March 27 of BOAC Top People for Beirut by MEA Comet. Pictured here with their wives are (left to right) Mr Basil Smallpeice, managing director, Sir Matthew Slattery, chairman, and Mr Keith Granville, chairman of BOAC Associated Companies

AIR COMMERCE

BOAC MEASURES THE RISKS

BOAC are on the point of deciding whether to reduce reliance on the London insurance market, to which the corporation pays nearly £2.6m per annum in premiums on its fleet. Hull insurance carried on 707s amounts to £1,960,000 per aircraft, for which BOAC are reportedly paying premiums of just over 1s in the pound. Just before leaving for Beirut (see photograph above) Sir Matthew Slattery, BOAC's chairman, said that "discussions are in progress with our brokers as to whether we should take this step. We could cover our own insurance and a fund would have to be built up. The decision will be announced within a fortnight."

BOAC have been pressing for a premium reduction following the experience of other airlines—notably their pool-partner Qantas—with self-insurance. In 1958, the latest year for which figures are available, a dozen world airlines held self-insurance reserves.

BEA, for the first time in that year, set £¼m aside for self-insurance (and have subsequently increased their reserve). Heaviest self-insurers in that year were TCA, £2¼m; Swissair, £1¾m; Air France, £1.15m; KLM, £1.15m; and Iberia, £0.8m. Others carrying their own risks to varying, though lesser, degrees were: Qantas, Philippine Airlines, United, Air-India, Garuda, and Sabena.

According to newspaper reports Lloyd's say that there have been insurance losses on air accidents in recent years. An underwriter is quoted by the *Daily Express* as having made the remarkable statement: "The trouble is that no airlines ever think of losses, they always think it will never happen to them." Repair costs of the BOAC 707 that ran off the runway at London Airport on Christmas Eve are estimated at £500,000. The SAA Boeing 707 which crash-landed at Nairobi last autumn cost £750,000 to repair.

BEA HAS £1m FOR A RAIL LINK

LORD DOUGLAS of Kirtleside, BEA's chairman, has reiterated his offer of up to £1 million towards the cost of providing a monorail from the centre of London to Heathrow. It is not that BEA (or BOAC) necessarily believe that a monorail is the right answer to a rail link between airport and city centre, only that a rail link of some kind is needed if there is ever to be a speed-up in journeys over short hauls such as London - Paris. In the current issue of the *BEA Magazine* the chairman has some arithmetic to show that to save ten minutes at each end of the flight on flight time alone would require a cruising speed of 1,000 m.p.h.—a supersonic effort that could easily be equalled by increasing the efficiency of ground transport.

BEA favours a rail link firstly because road traffic has a tendency rapidly to catch up with road capacity, and secondly because road transport may be a limiting factor in city-to-city transport as automatic landing aids are introduced. The day may not be far distant when the motor car, not the aeroplane, is the vehicle most restricted by bad weather.

AIR SAFARI HERALD?

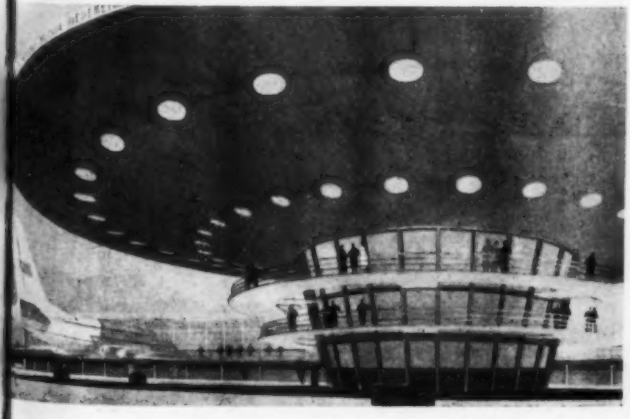
IT comes as no great surprise that Air Safaris are to evaluate the Handley Page Herald, nor that they were to make, last Tuesday, a "surprise" visit in the aircraft to Sandown, Isle of Wight, terminal point of a new Heron service to Birmingham and Newcastle upon Tyne. In November last year, when Air Safaris took over Don Everall, the intention was announced of operating Herons and then possibly Heralds on routes for which Don Everall had applied—notably from the Midlands to Guernsey or Jersey.

Air Safaris now see the turboprop Herald as a possible supplement to their Vikings and Hermes, for use on new domestic and Continental services which are planned or approved. A licence for up to eight return services a week has been granted for the Sandown-Newcastle route, and operations should start on June 3. A service from Hurn to Exeter, Birmingham and Newcastle—in effect an extension of the Birmingham - Exeter route for which a licence was held by Don Everall—is also to start in June. Two new international services should begin this month. The first, now awaiting Belgian Government approval, is to Amsterdam and Ostend. The other service, starting a week later, on April 15, is to Dublin and Belfast. All these routes will initially be operated by Vikings, but could possibly be better served by Heralds.

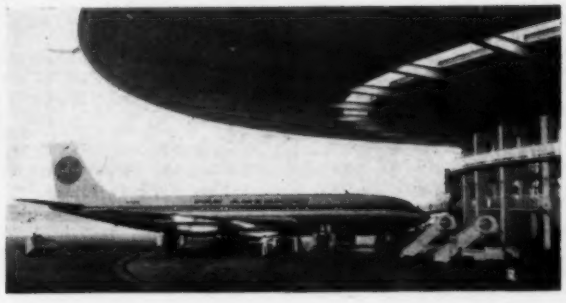
FOURTH SECTOR INVESTIGATION

PENDING the result of a scientific inquiry into the amount of nervous strain involved in flying European routes, BEA's Comet pilots are this summer to work the fourth sector about which they have recently again been protesting. In a way, reference of the problem to the flying personnel research committee of the Air Ministry is vindication of the pilots' viewpoint. As was recorded in a paragraph on these pages on February 24, the pilots have been standing by a suggestion of the arbitration board which studied the problem in March 1960 that workload should be objectively and amicably assessed by the pilots and the corporation.

The investigation is to apply to a cross-section of BEA's pilots, including those on Herons and Vanguards. Random selection is likely, the committee's brief being to "determine the work load and working conditions of BEA's pilots, with particular reference to the physiological and psychological aspects." The study began on March 27.



To be built at Moscow's new airport at Sheremetyevo (left) is this two-storey circular building for handling Aeroflot's jet fleet. It makes an interesting comparison with PanAm's circular terminal building at Idlewild (below), to which it is strikingly similar



Switched on for the first time as dusk fell one evening just before Easter was Luton Airport's new GEC approach and lighting system (see "Luton Lights Up" below). Note the 12 visual glide-path indicators set in two lines at the beginning and end of the touchdown zone

AIR COMMERCE ...

DOGS IN BEA'S MANGER

IN the past it has usually been BEA's policy to route services from the provinces to the Continent through London, until sufficient traffic has been built up to justify a direct service. It is an obviously sensible interim arrangement to specify an optional stop at London; an example is the Manchester - Milan route.

According to BEA, results on this particular service have been disappointing since it was started in 1955—largely due, BEA told the Air Transport Licensing Board at a recent hearing, to the fact that it has not been very well supported by the Manchester public. The corporation was asking the Board if it could add Birmingham as an optional intermediate traffic stop. The application was being objected to by both Cunard Eagle and by British United Airways.

This was the first clash between a corporation and independents before the Board, and it took place at the third hearing, on March 22. Mr Henry Marking submitted that the Manchester - Milan service had to be put on an economic footing; the way to do this, and at the same time to give Birmingham a direct service to Milan (there being a motor industry affinity between the two cities), was to include an optional stop at Birmingham. Anticipating the objections of Cunard Eagle and British United, Mr Marking said: "Here we have two companies, two leading so-called independent operators, who like to think of themselves as champions of competition," objecting to the proposed service. Neither had applied for the route, yet both wished to deny Birmingham a direct service and to deny Manchester the benefit of larger and faster aircraft (also being applied for by BEA was the right to introduce Comets, Vanguards and Tridents on the route). "I think I can see," said Mr Marking, "two little dogs peeping over the top of the manger." What these independents wanted, he said, was not competition but protection. BEA's application was then supported by Mr Jackson of the Birmingham Corporation.

Mr K. R. Sangster, recording British United's objection, said it was an observation rather than an objection. He thought that if more capacity was going to be provided "we contend it would be more in the interests of the travelling public if the traffic were routed via Gatwick rather than Heathrow." The chairman asked whether that was all he wanted to say and Mr Sangster replied that it was.

Mr Ashton-Hill for Cunard Eagle said he was a little amused to hear Mr Marking saying that the independents were not seeking competition but protection. "I hope," he observed, "that he will still be of the same frame of mind when our applications to operate European services come up."

Eagle's objection to the BEA application was that it did not want its position undermined by BEA pending hearings into the European services for which Eagle had applied. To a remark by Mr Jackson of the Birmingham Corporation that Cunard Eagle had been approved in 1955 for services from Birmingham which had never been taken up, Mr Ashton-Hill replied that this was going back into history; Mr Jackson was not as familiar as the independents were with the problems existing before the new licensing Act.

LUTON LIGHTS UP

CONSENSUS of opinion of visitors to Luton who recently sampled the new runway lighting from the air was that the borough had done a very good job. It was a clear night, and at maximum intensity the approach, threshold and runway lights were of dazzling brightness. The lighting is unambiguous, with the possible minor exception of the turn-off onto the taxiway centre line, and includes a full visual glide-path pattern of 12 VGPIs, similar to that installed at London Airport.

With its new 5,532ft runway, full lighting, and plans for a new terminal building with Customs and immigration facilities, Luton is making a determined effort to become the major airport in the north London area. Space has been set aside for additional hangars, and the 3,600ft north-south grass strip—now being extended to 5,000ft—may eventually become another concrete runway. Luton is 30 miles from London, but only two miles from the M1 motorway serving the northern outskirts.

Though commercial charter and scheduled services are limited to those of three operators—Derby Aviation, BKS and Autair—on total movements (see table on opposite page) Luton can claim to be Britain's eighth busiest airport. It is KLM's No 1 alternate to London.

Installation of the GEC lighting was undertaken over last autumn and winter by C. Maurice Contractors Ltd, under the direction of the borough engineer, Mr F. Oliver. It comprises green taxiway lights, elevated high-intensity runway lights, green threshold lights, and high-intensity uni-directional and red omni-directional approach lights. The centre line extends 1,000ft from the threshold and has one 100ft-wide crossbar—some pilots might like to see this increased, particularly when an approach aid is installed.

Much trouble has been taken to minimize damage should an aircraft leave the runway. The elevated lights are on frangible stalks projecting from concrete blocks sunk 15in below ground level, and the VGPIs, which give a 3° glidepath, have glassfibre casings. To give approach clearance, the west threshold is displaced 300ft down the runway and the east, 700ft. A new beacon, flashing a green "LT," completes the installation; a photograph of it being lowered into place by a Helicopter Services Agusta Bell 47G appeared in *Flight* last week.

Mr BAMBERG ON PRIVATE ENTERPRISE

THE case for a bigger independent-airline share of British air transport was the subject of a recent lecture by Mr Harold Bamberg, chairman and managing director of Cunard Eagle Airways. Entitled *Additional Enterprise in British Air Transport*, it was presented to the Society of Licensed Aircraft Engineers at the Royal Institution of Naval Architects in London.

Air transport, said Mr Bamberg, was the only British export trade restricted in effect to a single trader. It would surprise everyone if the British Motor Corporation were to ask for a similar

Just installed at International Aeradio's air traffic control school at Southall, Middlesex, is this Redifon surveillance-radar training equipment. Two courses are offered, one of seven weeks ab initio, and one of two weeks as a refresher. All UK radar controllers are now required to be licensed, which is the reason for this theoretical training

A new BEA service to Budapest was opened on April 3 in partnership with Malev. The Hungarian airline will use Ilyushin 11-18s and BEA will operate Viscounts, each twice-weekly. Seen here at Ferihegy Airport is V.806 G-APIM on a pre-inaugural proving flight

monopoly. "If you restrict air trade to a single carrier," he said, "the growth of this dynamic industry is bound to be limited." Some people said that air transport was different because trading rights had to be negotiated; but this was not true of the Colonies, thanks to which Britain was "in a better bargaining position than any other nation, including the USA."

Some people believed that State ownership was the best way of running an industry, but they overlooked the achievements of firms like Sainsbury, Ford, Woolworth, Lipton and so on "who have had the men and women with the small purse in mind." And to have an industry, especially one as dynamic as air transport, rationalized from the start was restrictive to new ideas. He had "no hesitation in saying" that the impetus for the low-fare Skycoach services came from British private enterprise.

The Americans, French and Canadians had found it possible to license "plurality of enterprise," and British Ford "would rather see an order go to Vauxhall than lose it to Volkswagen"; there was a harmony of interest and sentiment in British trade.

There was, he went on, a need for "individuality of enterprise and the inception of new ideas in our industry." Size and age were not necessarily synonymous with drive and initiative. And British success in aircraft manufacture depended on a thriving native user demand; the size of our aircraft industry, he said, "must depend on the size and strength of our operating industry." It was not easy for one carrier to support aircraft development, "but the whole economic picture changes when there is more than one carrier." The British aircraft industry, he thought, "have got an uphill fight with the Americans, in every facet of production."

Among the points made by Mr Bamberg during the discussion were that, in his view, air cargo "woke up about a year ago." But it was important that Customs co-operated fully; a lot of documentation was out of date, and Customs could be extremely helpful in eliminating formalities. Zurich-New York cargo, for example, might take 72hr to clear in London.

On the subject of traffic rights, there was nothing against a second British carrier on the North Atlantic; and though IATA controlled fares, individual airlines could influence fare levels—"BEA have persuaded 18 other countries to reduce fares in Europe." There was always the possibility of the open-rate situation, as was now likely in respect of North Atlantic cargo.

Asked how independents could break into the corporation pool agreements that appeared to restrict independent opportunities to expansion, Mr Bamberg admitted there were difficulties and that some share of the cake would have to come from BEA. But it was, he said, difficult to generalize about pools and bilateral agreements —"not all nations take a restrictive view as regards traffic rights." There were difficulties, "but this should not affect the Air Transport Licensing Board considering a bigger share for private enterprise."

BRITAIN'S BUSIEST AIRPORTS

A PARAGRAPH on these pages last week dealt with the growth of Britain's airport traffic in 1960. The table below, which supplements it, shows which airports handled the larger share. Three indices of workload have been taken; total movements, which include take-offs and landings by light aircraft on training flights; air transport movements, and passengers handled. London (Heathrow) easily tops the list and Southend's air traffic controllers can claim without fear of contradiction that their workload is second only to that of London. Another feature of this table is the relative position of Gatwick; although the runway is now quite busy, air transport movements are still only two-thirds of total movements, so that the passenger building is probably still working well below capacity. Glasgow's place is also interesting, since nearly all its movements are made by air transport aircraft.

Airport	Total movements	Airport	Air transport movements	Airport	Passengers handled (thousands)
Heathrow	146,506	Heathrow	135,468	Heathrow	5,380
Southend	69,991	Southend	33,446	Manchester	751
Gatwick	35,848	Ferryfield	32,610	Glasgow	652
Manchester	34,029	Manchester	28,346	Gatwick	475
Ferryfield	33,716	Glasgow	22,244	Belfast	428
Blackpool	32,460	Gatwick	19,593	Southend	381
Birmingham	31,190	Belfast	14,044	Prestwick	301
Luton	29,232	Birmingham	11,747	Birmingham	283
Prestwick	24,671	Prestwick	9,262	Ronaldsway	275
Stansted	24,049	Hurn	9,096	Edinburgh	224

Note: Channel Islands aerodromes are not included

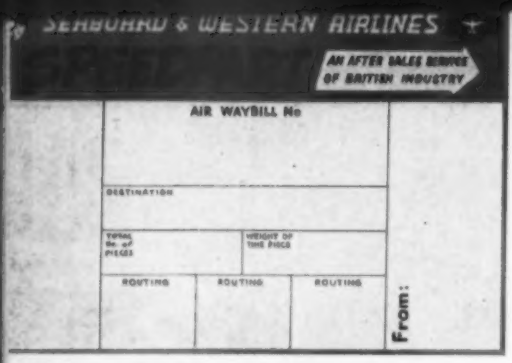
The Government have recently made a present to Mali of three DC-3s. They were bought from BEA for a sum, inclusive of delivery charges and other items, of about £75,000. Mali, the newly independent West African state, is to be supplied by the USSR with 11-18s, 11-14s, An-2s and Mi-4 helicopters, as well as airport equipment

A GUIDE TO RED TAPE

UNTIL April 11 last year there were as many sets of regulations governing non-scheduled airline operations as there were countries. On that date 14 European countries, including the UK, implemented an agreement on a common set of rules which we described as a small but significant step towards the elusive ideal of freedom of the air. Cargo flights in particular were allowed out on parole. The full context of the agreement was published by HM Stationery Office in command paper Cmnd 1099. The countries concerned were: Austria, Belgium, Denmark, Finland, France, West Germany, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey.

The Ministry has now published a helpful civil aviation information circular, No. 30/1961, which provides guidance on the red tape (the Ministry does not of course use this expression) with which countries entwine non-scheduled operations. The circular points out that the 1960 Civil Aviation Licensing Act does not affect "any need there may be for obtaining prior permission [for non-scheduled flights] from other civil aviation administrations." Annexes to this circular, which should have a place in every airline's commercial department, summarize the requirements of 42 countries. Any queries should be directed to the Ministry of Aviation, Branch ACG4, Shell-Mex House, Strand, London, WC2, telephone Temple Bar 1207, extension 297 or 769.

The European amnesty, after a year's experience, seems to be working well, although some UK airlines are worried about the amount of inclusive-tour business being booked with UK travel agents by foreign operators such as Société Area Mediterranea and Balair. British operators, who have to apply to the Air Transport Licensing Board for the necessary B licence, feel that this procedure is losing them business to foreign operators. This at any rate is what they say, though it is difficult to obtain chapter-and-verse about these complaints.



A new label for speeding up the ground handling of air freight —see "Speedpart Service" below

AIR COMMERCE . . .

SPEEDPART SERVICE

URGENT spare-parts consignments carried by Seaboard & Western are given the "Speedpart" label illustrated in the photograph above. The service is designed, say Seaboard, to impress agents in the United States that British manufacturers are alive to the value of air freight as a means of shrinking the supply line between constructor and customer. It applies particularly to fast-moving motor car spares. Another purpose is to speed-up the identification of packages and to develop a swift documentation service, for which there is no extra charge.

Documents relating to Speedpart consignments are placed in a "Speedagent" envelope in London, and at New York International are the first items to be handed in. Clearance formalities can be started before the first fork-lift truck has reached the aircraft, Seaboard's best time for handing over a Speedagent envelope so far being 17min after touchdown.

Here is a service which might with advantage be examined by the aircraft industry, which, as a matter of business practice, is now expected to hold stocks of all but the fastest-turnover spares for rapid delivery to operators. When the Canadair CL-44 is introduced on the Atlantic in July, very large items will be capable of being air-freighted at short notice.

IMBROGLIO FIUMICINO (Continuoso)

SLASHING criticisms of Fiumicino Airport by almost every major Italian newspaper on the scores of cost, amenity, situation and operational practicability may soon be answered. A commission of inquiry, composed of 15 deputies and 15 senators, has been proposed by the Italian Senate public works department, which was responsible for Fiumicino's construction. The commission is to report to the Senate by June 30.

Its official terms of reference are: "To ascertain if, in the choice of terrain, in its acquisition, in the tenders for the drawing-up of plans, in the choice of plans and in their alteration, in the allotting and granting of contracts for the construction work and for equipment and services, in the execution and control of the work, in supplementary reports, in the setting-up and in any other activity directly or indirectly connected with the construction of the airport of Fiumicino, the political and administrative organs of the State —whether central or local—have committed malpractice or have had knowledge of any and, in this latter case, to ascertain what measures to adopt to eliminate and punish those responsible."

BREVITIES

IATA has extended until June 30 existing Atlantic freight rates. They were to have expired on April 10.

Due back at Toulouse on March 29 was Caravelle 6 No 19 with which Sud have been carrying out hot-and-high tests based at Johannesburg.

Cunard Eagle's DC-6A G-APOM was destroyed in a training accident at Shannon on March 26. The crew of six escaped uninjured when the aircraft caught fire during touch-and-go landing practice.

Aeroflot and United Air Lines have signed an interline agreement providing for the issue of a single ticket for passengers or cargo flying the routes of both carriers.

Capt W. D. Wellwood has been elected chairman of BALPA in succession to Capt D. F. O'Sullivan. Capt S. L. Arnold-Boakes has been re-elected vice-chairman.

KLM announce that Mr E. H. van der Beugel's appointment as president will take effect from the date—some time in May—on which Mr I. A. Aler retires. Mr F. Besançon will become deputy president.

Dr Kenneth G. Bergin, BOAC's director of personnel and medical services, has accepted two new appointments: adviser on international quarantine to the World Health Organization, and member of the Council of the Air League of the British Empire.

Cunard Eagle's US foreign carrier permit has been extended to include the right to operate from Nassau to Palm Beach, Fort Lauderdale and Tampa. Hitherto Cunard Eagle's permit was for Miami only, Bahamas Airways being the only Bahaman airline to have rights to the other three points.

The revised bilateral agreement between the Scandinavian countries and West Germany, which caused bitter dispute between SAS and Lufthansa last year, reduces the number of SAS intermediate landings for transit traffic via Germany from 25 to 16 per week. In addition SAS will make about 50 flights per week to and from seven points in Germany. The compromise gives Lufthansa a larger share of the German market.

The Austrian airline AUA is to open a Viscount service from Innsbruck to London on May 1.

The CAB held a hearing on March 30 into BOAC's application to extend its New York route to Santiago via Cuba, Panama, Ecuador and Lima.

Starways have applied to the Air Transport Licensing Board for four scheduled services originating from Chester (Hawarden) to Jersey, Belfast, Isle of Man and Dublin.

Capt P. E. Bressey of IFALPA and BALPA has been elected chairman of the ICAO Visual Aids panel. This is the first time that a delegate representing IFALPA has been appointed to an ICAO post.

Business settled through the IATA Clearing House in London in 1960 amounted to more than £547m compared with about £362m in 1959, an increase of more than 50 per cent which, when adjusted for a procedural re-arrangement, was actually an increase of about a third.

Discussions on a united Arab airline, first held last year in Cairo, were resumed in Baghdad on March 26. Each Arab government would hold up to 20 per cent of the £27m capital, towards which Iraq has agreed to contribute 15 per cent.

Air France will operate one London - Paris service daily from Gatwick between April and October, and an additional flight during July, August and September. The remaining services (nine in the summer) and London - Nice services will continue to operate from Heathrow.

BOAC and Elder Dempster Lines are to relinquish their joint 49 per cent shareholding in WAAC (Nigeria), so that Nigeria Airways can become a wholly national airline. WAAC (Nigeria) have operated Nigeria Airways since July 1958.

Just published by IATA is a new Mileage Manual which will be the "authoritative statement" on distances between selected pairs of 1,600 cities. It will be used for the computation—eventually electronically—of fares between 70,000 pairs of points in the world. The 420-page document is the result of nearly three years' work by a special IATA computer working group. One of the three chairmen was Mr L. H. Bateman of BOAC.

TWA has been without a president since Mr Charles Thomas resigned last July. The new man, Mr Charles C. Tillinghast, takes office on April 17

New commercial manager of Derby Airways is Capt T. A. J. Mayo. He was previously western region manager at Staverton Airport, Gloucestershire

THE SUPERSONIC TRANSPORT (Continued from page 430)

wholly in this form would not be very much heavier, relatively, than an equivalent aluminium-alloy structure unaffected by heat.

Many problems in the aircraft main systems also increase in severity as the temperature rises with increasing speed. This is fairly obvious when it is appreciated that the aircraft skin temperature rises from 110°C at M2.2 to 275°C at M3. One example is the air-conditioning system. The air supply is delivered from the main engines at about 300°C, and the method proposed for cooling this air is to pass it through fuel-cooled heat exchangers. In the case of the M2.2 aircraft, the combined heat input to the fuel from the heat exchangers and from surface conduction is just tolerable, thus allowing mainly conventional stowage of fuel in wing tanks. At M3, however, the tanks must be properly insulated, and it is necessary to install much of the tankage within the air-conditioned fuselage. This, in turn, interferes with the passenger accommodation. For good measure, it is interesting to speculate on the hazards associated with possible fuel or vapour leaks when the temperature of most parts of the skin of the main structure is higher than the spontaneous-ignition temperature of conventional hydrocarbon fuels (about 250°C).

Other problems include the cooling of hydraulic systems and electrical components. In cases where cooling is not possible, new transparent materials including radomes, new body leak sealants, electric insulation and bearing lubricants must be developed. Alarming technical difficulties have not usually deterred the aircraft industry, providing that there is a strong probability that eventual results will justify the effort. Now it must be proven that a supersonic transport could be operated in economic competition with conventional aircraft on a sufficient number of international routes.

Problems associated with aerodynamics and the powerplant cause relatively less concern when compared alongside those of the structure and functional systems. In the M3 regime, the general state of the art makes it difficult to guess the magnitude of the task of developing and proving the reliability of the main systems under proper environmental conditions. Also, further uncertainty arises over the extent of flight-testing necessary to demonstrate that no aspect of safety falls below present airworthiness safety standards. It must be remembered that, hitherto, most features adopted for successful civil airliners, including their operating speeds, have lagged seven to eight years behind military experience.

Leaving the foregoing problems aside and assuming that they can be solved with sufficient effort applied, estimates have been made of the weight of an M3 airliner when carrying the same arbitrary payload as assumed for the M2.2 airliner. These weights have been compared and seem consistent with information obtained from various sources in the United States. The results are shown in Table 2.

The next step is to compare block times. These are shown in Fig 4. In both cases some 700 miles are flown in climb and descent at an average speed of less than M1. It can be seen that the M3 aircraft saves about 30min and 20min on a 3,000 n.m. and 2,000 n.m. sector, respectively.

Turning now to the crucial question of direct operating costs, I propose to approach in the reverse of the usual direction. The results are illustrated in Table 3, with the following explanations.

Assuming that all aircraft have the same useful life and annual utilization, the relative revenue-earning capacity per pound of aircraft empty weight is shown in Line 4 to be 0.64: 0.90: 0.94.

Assuming that the cost of fuel is 14.4 c/US gal, the respective fuel costs per passenger mile are 0.37, 0.65 and 0.78 cents (Line 7).

Assuming for the subsonic aircraft that the fuel costs represent 27.5 per cent of the *total* direct operating costs, then the "reference d.o.c." becomes 1.35 cents per passenger mile (Line 8).

If all three aircraft are to have equal d.o.c.s, the allowance for all contributing items except fuel can be obtained by subtracting the fuel costs from 1.35 cents, i.e. 0.98, 0.70 and 0.57 cents per passenger mile (Line 9).

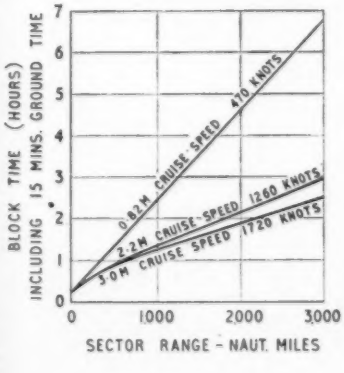


Fig 4 (left). These curves suggest that an increase in cruise speed from M2.2 to M3 is not reflected in a substantial reduction in block time

As a rough approximation, the costs in Line 9 may be taken as proportional to initial aircraft price. The major contributions are amortization, insurance, spares and maintenance.

Each pound of empty weight can be regarded as having a specific earning capacity (Line 4) and bearing a share of the selling price. Therefore, multiplying the values in Line 4 by those in Line 9, i.e. (passenger miles/lb) × (cents/passenger mile), gives a measure of the "allowable selling price" per pound of empty weight (Line 10).

The values in Line 11 show that for equal operating costs, the M2.2 aircraft must not cost more per pound than the subsonic aircraft, the M3 aircraft must cost 10 per cent less. As regards the complete airframe plus engine selling price, both supersonic aircraft as defined should not be more than 20 per cent above the subsonic aircraft (Line 12). These aircraft prices increase at a lesser rate than the corresponding earning capacities on account of rising fuel bills.

If it is assumed that the direct operating costs of the supersonic aircraft can be 15 per cent higher than for the subsonic aircraft, the resulting costs per pound of empty weight and the total aircraft prices are shown in Lines 16 and 17. The corresponding aircraft price can now be 50 per cent higher for the subsonic aircraft.

The economic selling price of an aircraft falls as the number of aircraft produced increases. In the first place, more comprehensive jigging and tooling is possible, and improved efficiency of shop labour is acquired by practice. As a general engineering rule, doubling the quantity makes it possible to reduce the production cost of each unit by about 20 per cent. In the second place, the amortization of development costs are spread more thinly.

Among the many factors which lead to the higher costs of the M3 aircraft are higher development costs, higher material and tooling costs, higher workshop manhour content, lesser experience in fabricating techniques and greater complexity of certain systems.

The important observation to make on Fig 5 is that if the M2.2 aircraft is to be economic for both operator and constructor, then approximately 50 must be sold. To achieve the same economic balance for the M3 aircraft at least 200 need to be sold. A reading of Table 3 and Fig 5 together shows that even supposing that technical engineering difficulties can be satisfactorily overcome, the advocates of M3 airliners still seem to be confronted with a formidable array of self-imposed difficulties.

"*Your wit's too hot, it speeds too fast, 'twill tire*".
—Love's Labour's Lost.

	M2.2			M3		
	F (%)	D (n.m.)	T(min)	F (%)	D (n.m.)	T(min)
Start to cruise ...	12.5	530	39.9	12.4	440	32.2
Cruise	21.7	2,270	108.7	25.3	2,340	82.1
Descent to stop ...	2.7	200	36.0	2.4	220	35.9
Reserves	7.8	—	—	8.2	—	—
	44.7	3,000	184.6	48.3	3,000	150.2
Installed engines ...	14.3			12.6		
	59.0			60.9		

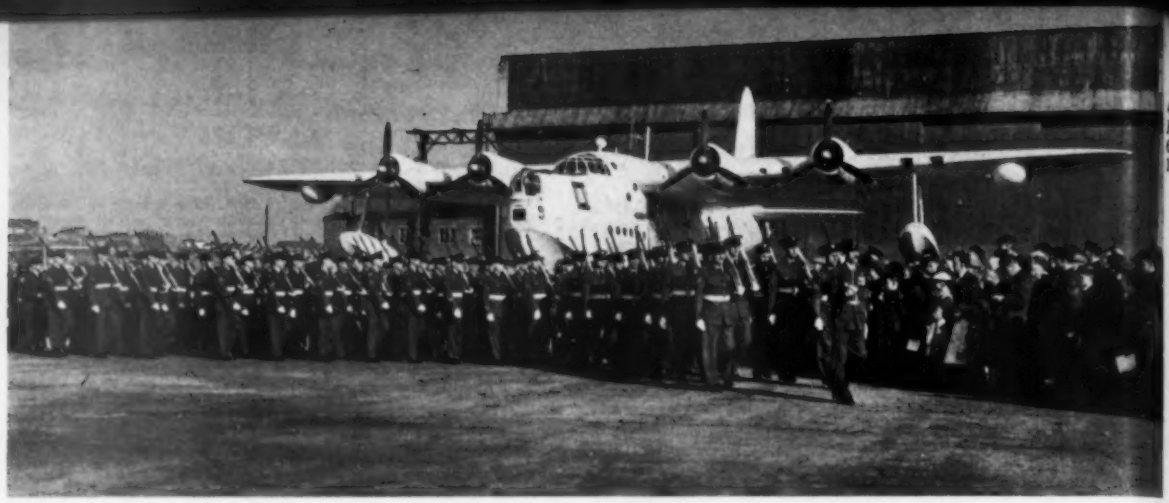
Table 1. Comparative fuel and engine weights for the two suggested cruising Mach numbers; F is the percentage of gross weight accounted for by fuel, D is stage distance and T is time

	M2.2		M3	
	%	lb	%	lb
a. Payload, crew, etc.	10.0	33,700	8.4	33,700
b. Weight empty, including engines ...	45.1	152,000	43.9	175,000
c. Fuel consumed	36.8	124,000	37.5	150,000
d. Fuel carried	44.9	151,000	47.7	191,000
e. Take-off weight (a + b + d)	100	337,000	100	400,000

Table 2. Estimated weights for airliners cruising at M2.2 and M3, carrying a payload of 28,500lb (120 passengers) over a stage of 3,000 n.m.

	A	B	C
(1) Operating weight empty (lb)	28,000	152,000	175,000
(2) Passengers	165	120	120
(3) Block speed (m.p.h.)	500	1,130	1,370
(4) Passenger m.p.h./o.w.e.	0.64	0.90	0.94
(5) Fuel consumed (lb)	98,000	124,000	150,000
(6) Fuel/passenger-mile (lb)	0.17	0.30	0.36
(7) Fuel costs/passenger-mile (cents) ...	0.37	0.65	0.78
(8) Assumed d.o.c. (0.37/0.275) (cents) ...	1.35	1.35	1.35
(9) Difference (8) minus (7)	0.98	0.70	0.57
(10) (9) × (4)	0.64	0.63	0.54
(11) (10)/0.64	1.0	0.99	0.88
(12) Ratio of unit cost $\frac{(11) \times (1)}{128{,}000}$	1.0	1.17	1.20
(13) Assumed d.o.c.	1.35	increased by 15 per cent	
		1.56	1.56
(14) Difference (13) minus (7)	0.98	0.91	0.78
(15) (14) × (4)	0.64	0.82	0.73
(16) (15)/0.64	1.0	1.30	1.13
(17) Ratio of unit cost $\frac{(16) \times (1)}{128{,}000}$	1.0	1.54	1.54

Table 3. Comparative operating economics for a representative subsonic jet transport (A), an M2.2 design (B) and an M3 airliner (C). Numerous assumptions made are explained in the text



Preserved for posterity at Pembroke Dock: Short Sunderland ML824 seen during the presentation ceremony on March 25, when it was handed over on behalf of the French Government to the Sunderland Trust ("Flight," March 30)

SERVICE AVIATION

Air Force, Naval and Army Flying News

92=111

SUCCESSORS to Treble One, No 92 Sqn are to provide this year's Fighter Command formation aerobatic team. Like their famous predecessors, they will fly Hawker Hunter F.6s; their commanding officer is Sqn Ldr Brian Mercer, formerly a deputy leader of Treble One's "Black Arrows." He will be at the head of a nine-man team which has recently been working up to display standards during an operational detachment in Cyprus. The 92 Sqn Hunters are wearing royal blue livery, with a white flash line; they have red-and-yellow chequerboard markings with the squadron badge (showing a cobra striking) on the nose.

No 92 Sqn was first formed in 1917, and in five months' operations on the Western Front before the Armistice accounted for 37 enemy aircraft. Its record in the Second World War was equally pugnacious. In two days in May 1940 its Spitfires destroyed 23 German machines and by the end of the war it had been credited with 317½ enemy aircraft destroyed, 107 probably destroyed and 184 damaged, living up to the phrase "aut pugna aut morere" ("fight or die") which forms its motto.

Reciprocal Hospitality

A GREEK F-84F Thunderstreak squadron has been visiting the Near East Air Force. Based at RAF Akrotiri, Cyprus, for three days (March 28 to 30), its visit was made at the invitation of the AOC-in-C, Air Marshal Sir William MacDonald. The Chief of Air Staff of the Royal Hellenic Air Force was represented by Brig-Gen E. Deros, Chief of Staff of the 28th Tactical Air Force. A Turkish Air Force squadron is due to come to Akrotiri in the near future. These visits reciprocate Turkish and Greek visits by RAF squadrons in 1959.

Boyd Trophy Winners

AT RNAS Culdrose on March 28 the Boyd Trophy was presented by its donor, Admiral Sir Denis Boyd, to No 831 Sqn. Awarded annually to "the most outstanding Fleet Air Arm squadron of the year," the trophy was received by the CO, Lt Cdr B. J. Williams.

His unit's prime function is to provide aircraft for weapon training exercises and to conduct tactical and equipment trials. The two flights ("A" with Gannets and "B" with Sea Venoms) are deployed at home and abroad, from the Arctic Circle to the Mediterranean, to perform these tasks; they are ready at short notice to embark in aircraft carriers, complete with their own maintenance personnel.

Bulwark of Safety

SPEAKING at Cranwell last week on his first visit to the RAF College the Secretary of State for Air, Mr Julian Amery, described the V-force crews as "the main bulwark of our safety today." He said to a parade of flight cadets: "Some of you will soon be joining Bomber Command. Believe me, there can be no finer mission for any young man in this country. It's my own view that so long as we maintain an effective British strategic striking force, we shall be safe from nuclear attack."

Referring to the future of the College, Mr Amery told the cadets: "As you know, we have decided to move the Technical College from Henlow and merge it with Cranwell in about three years' time when additional equipment and buildings are ready. You will have here a complete university of the air. This will deepen your understanding of each other's problems; it will also stimulate creative thinking about the baffling problems that face us in the air and beyond the air, in space."

Planning Directorship

A NEW post has been taken over by Air Cdre D. C. Stapleton, CB, CBE, DFC, AFC: he has become Director of Joint Plans at the Air Ministry, having been deputy Director of Organization since December 1959. During the war he commanded No 14 Sqn from 1940 to 1941, having previously served with it for over three years in the Middle East. One of his later wartime posts, after serving at AHQ Western Desert, was that of staff officer to the Vice-Chief of the Air Staff. Among his postwar appointments have been command of the Vampire Wing at Odiham (from 1949 to 1951) and of RAF Oldenburg in Germany.

IN BRIEF

RAF Hawkinge, one of the Battle of Britain fighter stations in No 11 Group, is to close at the end of this year.

A reunion of all former members of 98 Sqn is being held on May 27 at the RAF Reserves Club, 14 South Street, Park Lane, London W1. Those wishing to attend should contact the Officer Commanding, No 98 Sqn, RAF Driffield, East Yorks.

Commanders-in-chief of all the RAF Commands, at home and overseas: a photograph taken during the recent conference (this page, last week) held by the CAS, Air Chief Marshal Sir Thomas Pike, who is seated in the centre of the front row

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